Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

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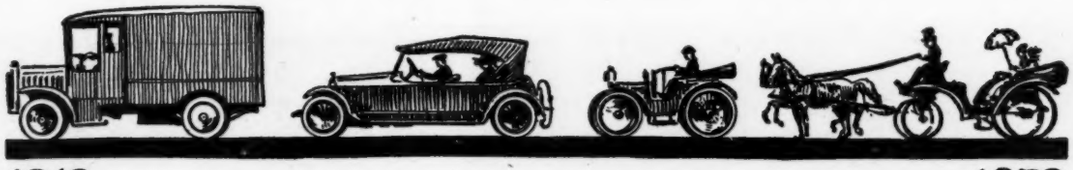

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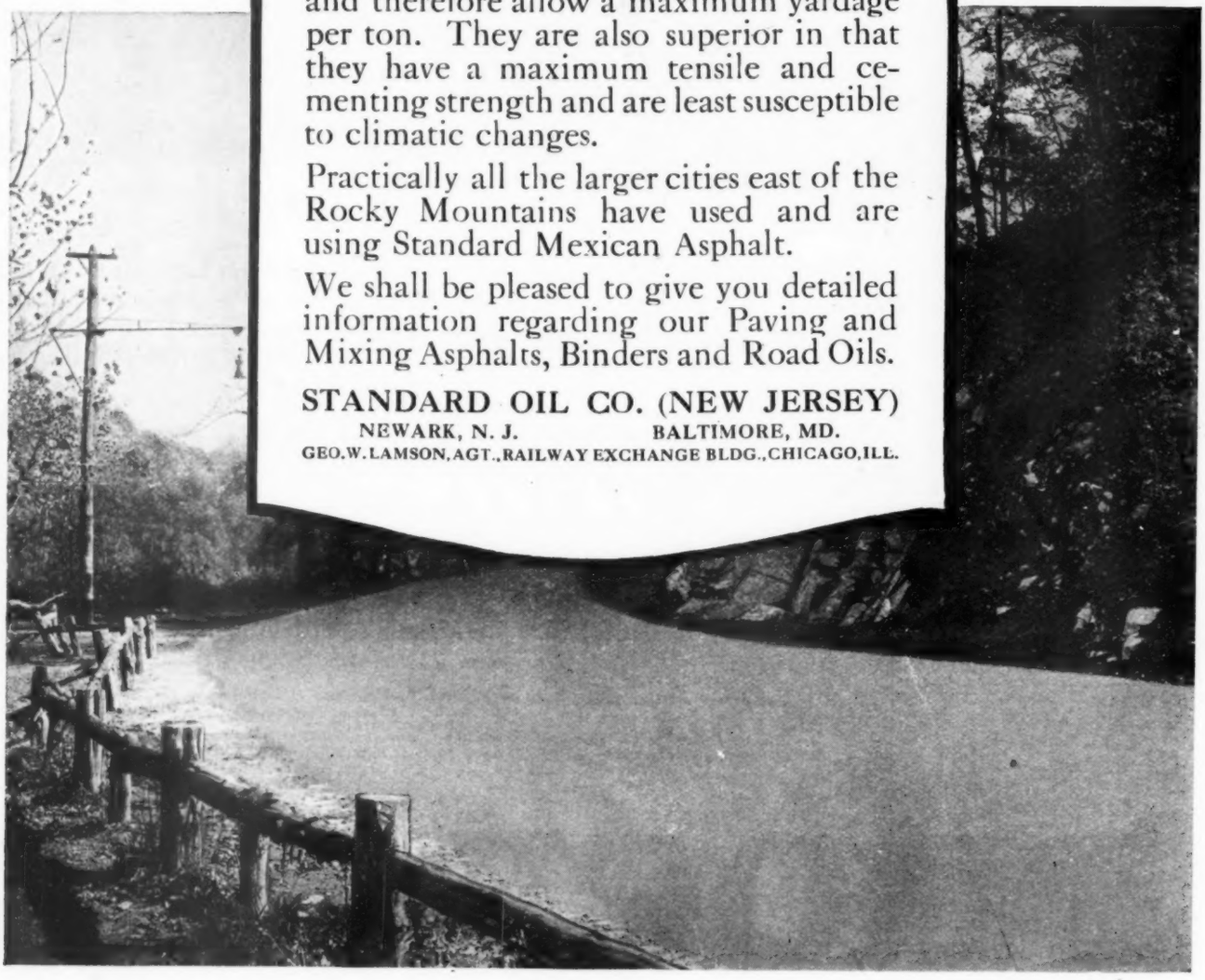

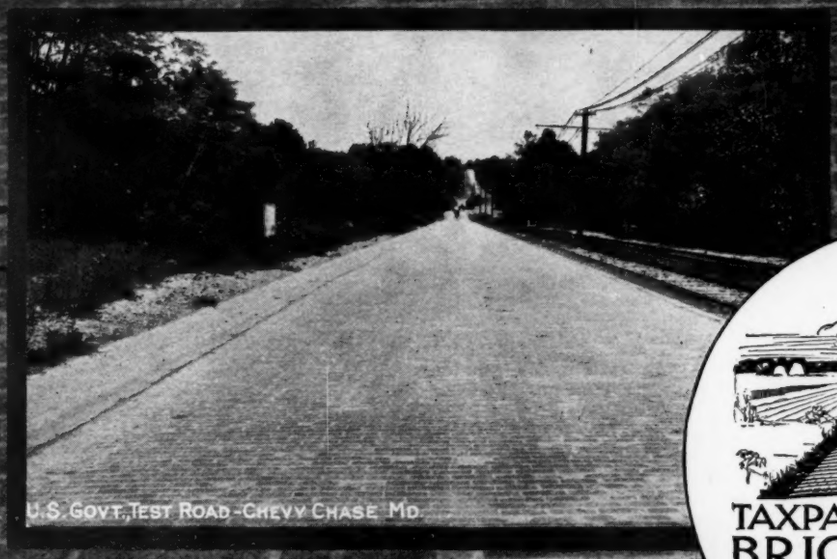

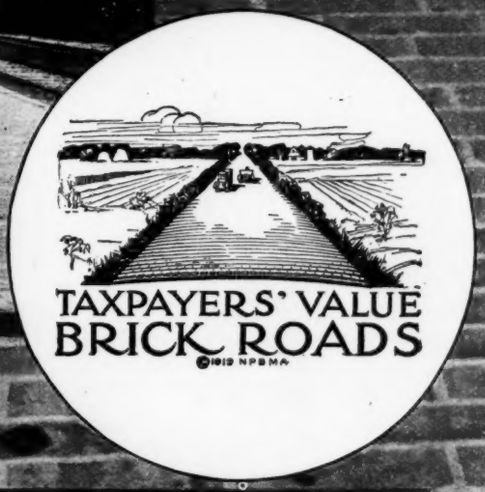

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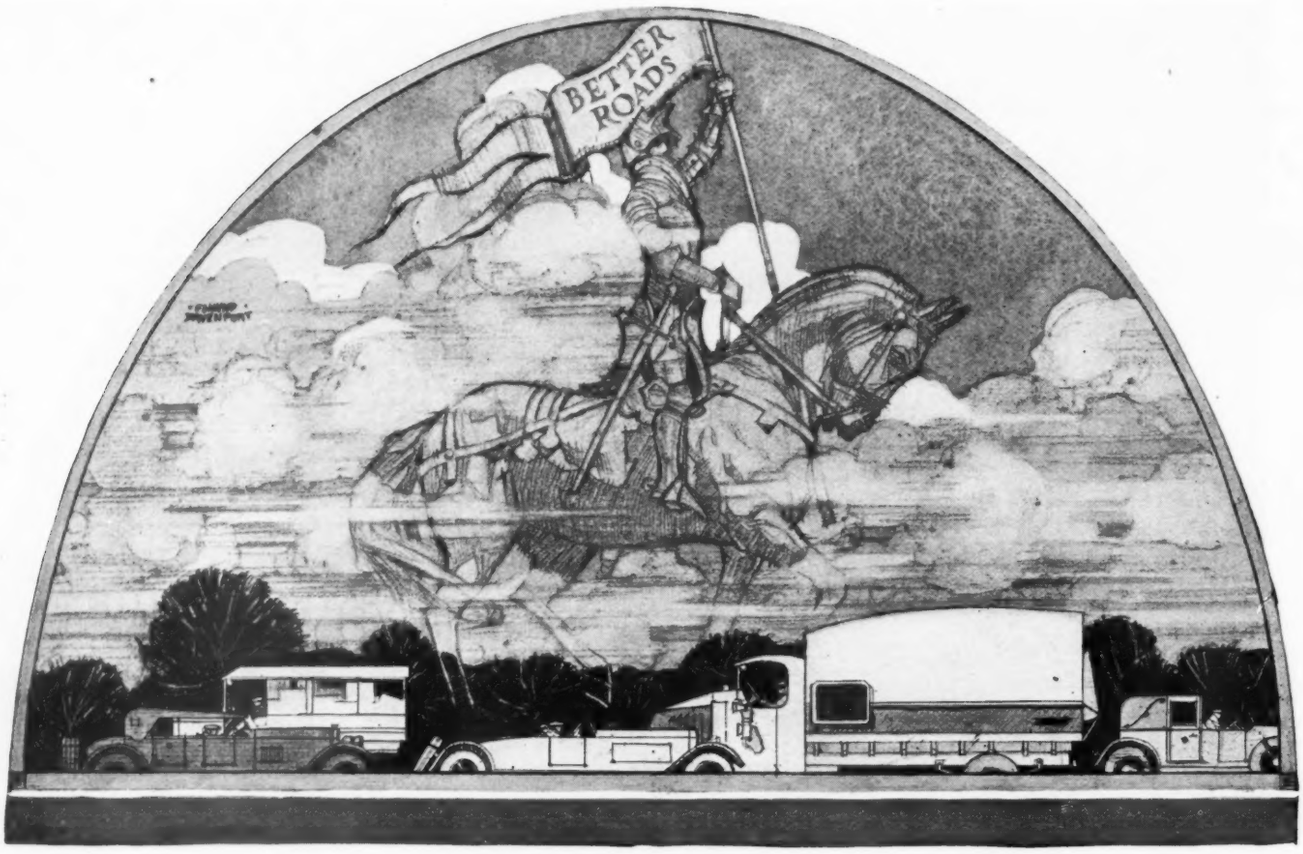

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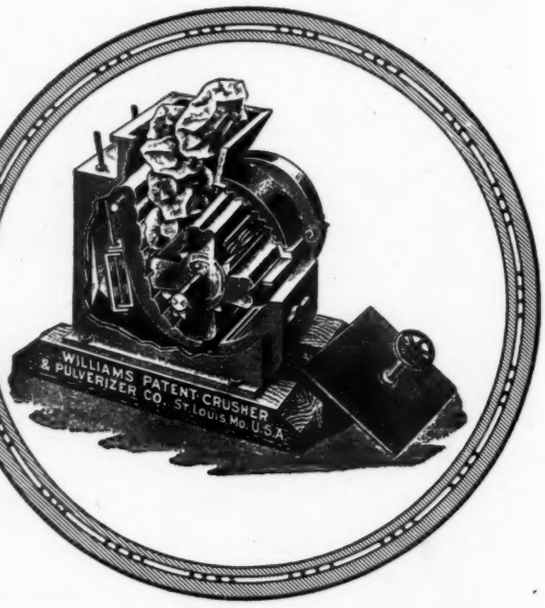

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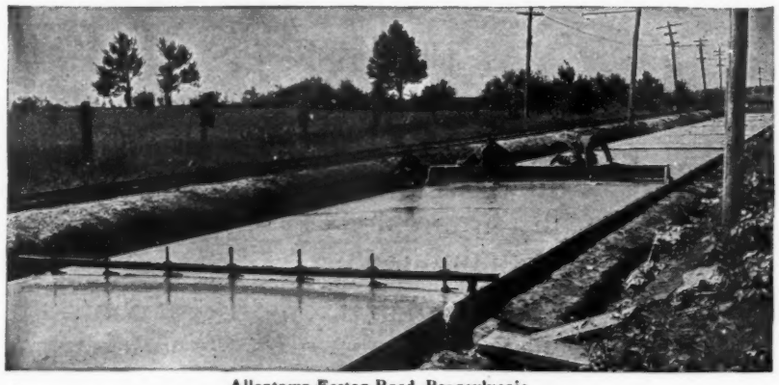

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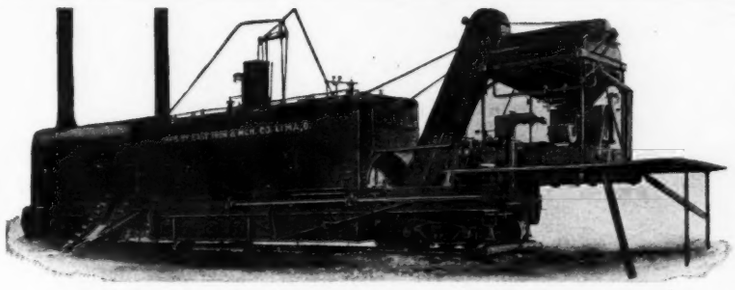

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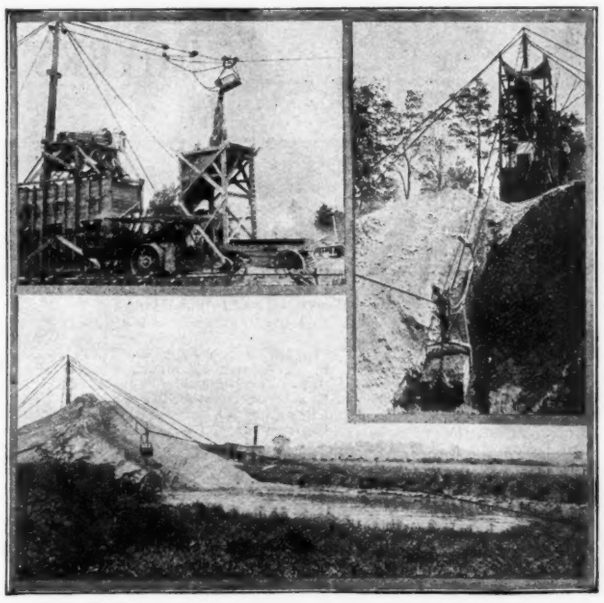

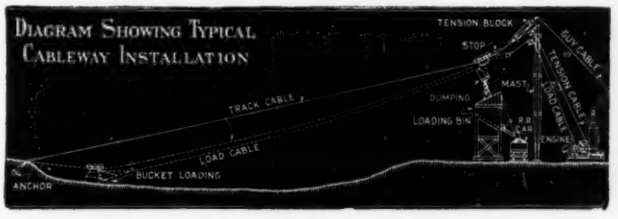

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It is demonstrated beyond doubt that to make concrete roads proof against heavy motor traffic, weather and time a fabric of steel must be incorporated in the concrete.

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Wood Block (Creosoted).
Barrett Co., The
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Wood Preservatives.
Barrett Co., The
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MOTOR TRUCKS

Motor Trucks as Operated in Municipal and County Service and in Highway Transportation

The Autocar Motor Truck has been approved and adopted by more than 1000 leading coal dealers because it meets successfully their exacting transportation demands.

This proved ability under supreme test has made the Autocar the standard transportation unit for representative firms in more than 400 lines of business.

More Than 1000 Coal Dealers Use Autocars

Its short wheelbase saves time in maneuvering through traffic. Its double reduction gear drive gives effective power at lowest cost. And it is backed up always by the unusual Autocar system of factory branch service.

CHASSIS (1½ TO 2 TONS)
$2300—97 inch wheelbase
$2400—120 inch wheelbase

THE AUTOCAR COMPANY
Ardmore, Pa. **Established 1897**
Factory branches and dealers in all principal cities

Autocar

Printed as insert to Municipal and County Engineering, Chicago, Ill., September, 1919.

MOTOR TRUCK OPERATION AND ACCOUNTING XLIX

The following paragraphs contain specific information on motor truck performance given out by truck users:

R. D. Coleman, county engineer of Atchison county, Atchison, Kansas, writes:

"This county has two Diamond T trucks, one a 3½ ton dump body truck and the other a 2-ton box body truck. These trucks have given extremely satisfactory service with practically no repairs in 15 months. They are operated under the supervision of the county engineer on road work."

Chas. Slemp, chief of the fire department of Anadarko, Okla., writes:

"We have had a Wichita truck in service in the fire station for five years, during which time it has given perfect satisfaction at a minimum expense of maintenance."

T. A. Work, dealer in builders' supplies, mill-work and hardware, 453 Alvarado St., Monterey, Calif., writes:

"I purchased two Moreland trucks about a year and a half ago and they have given such good satisfaction in performing all kinds of hauling and transportation that I have just added another to my equipment. They have also been the cause of my disposing of the other trucks I had on hand, as I find the cost of operating the Moreland less than any other truck I have ever used."

F. L. Stone, line foreman of the Buffalo and Lake Erie Traction Co., Buffalo, N. Y., writes:

"Regarding your inquiry as to Atterbury Tower Truck in use here would say that it has given good satisfaction and the expense of operation has been very reasonable. The chauffeur informs me that since January 1, 1919, our gasoline has been from 86 (lowest) to 132 (highest) gals., for a month, oil average 6 gals. per month. The repairs have only been minor. Truck has not been tied up for a day in this length of time. The motor has never given any trouble or delay in starting since we have had truck, although for three winters it has been in a garage without any heat, where it was necessary to drain water out of radiator each night to keep it from freezing. Taking into consideration the usage the truck has had night and day, both summer and winter, and the condition of the roads it has to travel, I do not believe we could have received better results with any other make of truck."

W. M. Hunter, corresponding secretary of Ridgefield Park Hose Co. No. 1, Ridgefield Park, N. J., writes:

"We have a 2½ ton model AB Mack combination chemical and hose wagon which has been in service since Jan. 1, 1918. It is a special type for fire purposes, chain drive, four speeds ahead, one reverse. It is loaded with 1,700 ft. 2½ in. rubber lined hose, with a 40 gal. chemical tank and equipment such as nozzles, spanners, etc., and carries 12 to 15 men. We have considerable dirt roads of the Jersey clay variety and up to date have had no trouble with the machine in any way and we have had several experiences of running in mud after a rain where the mud was up to the hubs of wheels without any difficulty. We are very much pleased with the performance of this truck which is built for service at all times."

Moreland Motor Trucks in Public Works Field

R. L. Warner of the San Diego, Calif., branch of the Moreland Motor Truck Co. (Los Angeles) writes of the performance of Moreland motor trucks in the public works field as follows:

"San Diego county has purchased four 4-ton trucks, with dump bodies and equipped with Wood's hydraulic hoist. These Morelands are used in road work. The city of San Diego has recently bought four 2½-ton Morelands, fitted with special garbage bodies; these trucks are operated as a municipal undertaking. Previously this work was done under contract; now, under the new system, the city not only is saving money by the use of the Moreland distillate truck, but is getting this work more efficiently done. Herewith is an illustration of three of these trucks. The San Diego Rubbish Company is operating three 2½-ton Morelands here and in Coronado, for the collection of rubbish in these cities. The San Diego School Board is using a 1½-ton Moreland truck for the delivery of supplies from their storehouse to the different schools. The city of La Mesa, near San Diego, has a Moreland truck equipped with fire-fighting apparatus, which is helping to guard the property of that city. There are four 4-ton Morelands doing contract work for the city of San Diego. These trucks are used in the work of constructing the new city water works dam at Otay."

Boston Motor Wrecker Has Wide Range of Utility

"I don't know what we'd do without the wrecker," remarked Charles E. Stewart, supervisor of motor apparatus of the Boston, Mass., fire department, in speaking of the Mack wrecker.

This wrecker was especially designed for the Boston fire de-

THREE OF A FLEET OF FOUR 2½-TON MORELAND MOTOR TRUCKS WITH SPECIAL GARBAGE BODIES, AS OPERATED BY THE CITY OF SAN DIEGO, CALIF.

Wilson

dependable MOTOR TRUCKS

BACK OF WILSON MOTOR TRUCKS is a Company with a business record of 36 years keeping its word to the public. *The J. C. Wilson Company.*

Back of the J. C. Wilson Co.

are the printed guarantees and the financial responsibility of the mammoth concerns whose reputation is based on the worth-while excellence of their various products.

This advertisement was compiled from the advertising of the firms supplying our major units.

MOTOR: Wilson Trucks use "a motor of proved dependability—a motor which has been thoroughly tested under every condition of service. It possesses power, endurance and, above all, reliability." Continental Red Seal Motor.

TRANSMISSION: "There is no weak point in Wilson transmissions. They never fail under severe service. Each part of the transmission has been correctly designed to co-ordinate with every other part." Covert Gear Company.

CARBURETOR: "Its name defines it. Economy, power, acceleration. Uses gasoline or distillate." Marvel Carburetor Company.

RADIATOR: "No engine can be more efficient than its cooling system." Long Radiator Company.

PROTECTION: Wilson Trucks are "protected by a superfine governor against excessive speeds. Reckless driving of any truck results in collisions, accidents, burned out bearings, scored cylinders, broken springs, stripped gears, loosened frame members and other things that put the truck in the repair shop." Pierce Governor.

AXLES: "The dealer is fast reaching the state when he cannot afford to sell a cheaply constructed truck. It is a losing proposition for him. In selecting a truck to sell, the progressive dealer investigates, first of all, the method of drive. He knows he can rely on a worm gear axle made by a reliable company, because none of them have ever worn out." Timken Detroit Axle Company.

SPRINGS: "Made by the largest spring makers in the world, by the most up-to-date methods. They stand upon their reputation." Standard Parts Company.

MAGNETO: "All competitive tests in times of war and of peace, have proven to the engineers that for an intense, fat, continuing spark, **Magneto Ignition is the most efficient and dependable,** and that for simplicity of design, ruggedness and absolute reliability, the **Eisemann Magneto is supreme."**

TIRES: "Guaranteed for 10,000 miles." Firestone Tire & Rubber Company.

STEERING GEAR: "Has such an unusually big bearing surface that it is easy to steer the truck under all conditions." Ross Steering Gear Company.

"A TRUCK IS NO STRONGER THAN ITS WEAKEST MEMBER. WHEN ALL ARE EQUALLY GOOD, IT FOLLOWS THAT YOU HAVE A GOOK TRUCK."

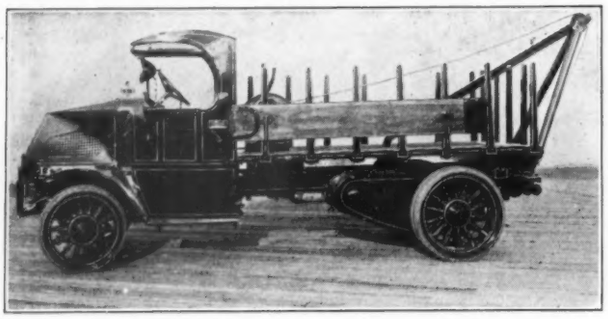
WILSON's are truly dependable motor trucks—1-2-3½-5 ton models—all worm drive

J. C. WILSON CO. DETROIT, U. S. A.

36th Year

partment by Mr. Stewart and manufactured by the International Motor Company.

The machine weighs approximately 7 tons. It is equipped with a fire department Mack A.C. motor and carries all kinds of wrecking equipment, such as jacks, bars, shovels, chains, ropes, repair tools, oil, and 50 gals. of gasoline to supply motor pumping engines at fires when necessary. In reality, it is a traveling machine and repair shop. It has a power winch and derrick on the rear that can lift 10 tons. It picks up a heavy



VIEW OF 7-TON MACK WRECKER, EQUIPPED WITH POWER WINCH AND DERRICK, AS OPERATED BY THE BOSTON, MASS., FIRE DEPARTMENT.

automobile and swings it around as if it were a baby carriage. It can even lift the end of a street car, if necessary, to release the victim of an accident. The towing of an 85-ft. extension ladder truck is easy.

The wrecker can make 40 to 45 miles an hour. The motor squad consists of six men, three of whom are kept on night duty.

The ordinary duties of the wrecker consist in towing in wrecked apparatus, delivering fuel and pulling down walls at fire ruins. It has frequently been used to rescue horses that had fallen into holes or ditches. In the past two or three years it has been called upon in several hundred accidents, and averages a dozen calls a week.

A practical idea of the utility of the wrecker is best gained from the following extracts taken from the "log" of the Boston fire department:

Conveyed divers and their outfits from the Navy Yard to Fenway Pond, near Westland avenue, Back Bay, the scene of a drowning accident. Assisted Ladder 15 and carried diving apparatus and men under command of Lieut. Pratt, of the U. S. battleship Virginia.

Towed in a wrecked Ford which had been smashed up opposite former Mayor Curley's house, in Jamaica Plain.

Responded to rear of 19 Cedar street, Roxbury, and, assisted by members of Ladder 12, under Junior Deputy Chief D. F. Sennot, and District Chief Caffey, removed a horse and cart that had fallen over an embankment into the cellar of a building.

Wrecker was used to rescue a horse which had fallen through a barn floor at 171 Blue Hill avenue.

Wrecker responded to fourth alarm from Box 1241, Battery Wharf, and removed two horses that had fallen into a trench on North street, near Richmond. Horses owned by fire department.

Wrecker responded to 167 Minot street, Dorchester, and, assisted by members of Ladder 27, under orders of District Chief Hefferman, removed horse from a manhole. Horse was property of city of Boston, sanitary service.

Perhaps the most spectacular feat performed by the wrecker was in February of 1918, when a horse and wagon fell into the harbor near the King terminal, in South Boston. The temperature was several degrees below zero, and the ground was so icy on the incline near the wharf that the firemen had to secure the wrecker with strong rope to prevent losing the big

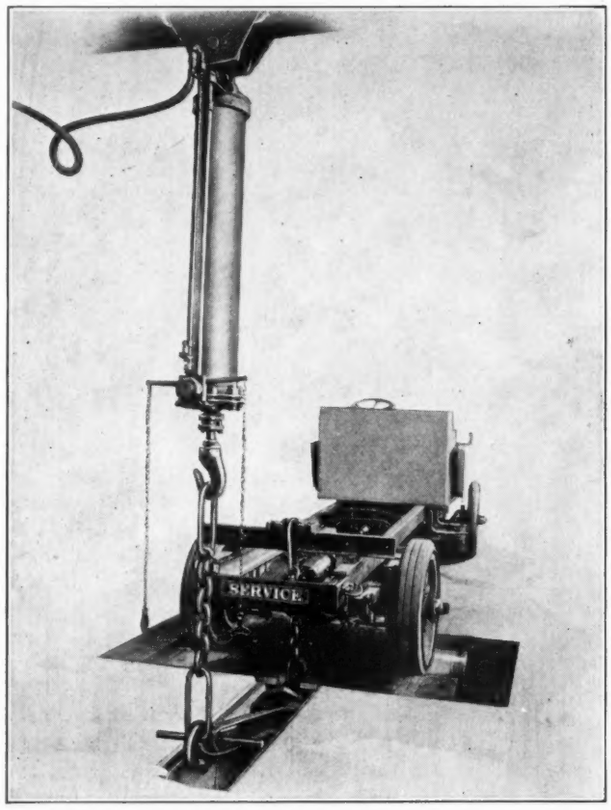
CONSULTING ENGINEER

offers his services for the selection of special motor truck equipment for municipal and engineering uses. For appointment write Captain Whittemore, 219 W. 81st Street, New York, N. Y.

machine while getting it into a position to pull the horse out of the bay, filled with ice, before the animal was drowned by the rising tide. It was 15 or 18 ft. from the pier head to the ice, but the horse was pulled out safely and the wagon was also recovered.

These incidents are only a few of the many outside jobs done by the wrecker. They do not include the regular fire department emergency work, which is performed as a matter of routine duty, with no special notice being given to it.

The Boston fire department states that there is no expense in maintaining the wrecker, except when it is in actual service, and that the cost of gasoline and repairs is trifling compared to the service it renders.



VIEW SHOWING HOW SERVICE MOTOR TRUCK DRIVING MECHANISM IS TESTED BEFORE LEAVING FACTORY.

Boston was the first city to adopt this type of machine. Since that time it has been adopted by leading cities in every part of the United States. New York, Chicago, Cleveland, Baltimore, and many other leading cities now have Mack wreckers as part of their standard municipal equipment.

Contractors and large fleet operators, also, find it profitable to own their own wreckers, and most large concerns are equipped with wreckers built to meet their own particular needs.

"Stationary Road Test" of Driving Mechanism of Service Trucks Made in Factory

Stationary or "block testing" is considered one of the necessities of motor truck engine manufacture. Test rooms are fitted up and machinery installed for the purpose of testing on

Service Flushers Effect Substantial Savings in Street Cleaning

The number of municipalities using "Service" motorized equipment is rapidly growing, because in work of this kind substantial economies are effected by the use of

Service MOTOR TRUCKS

Indianapolis is one of the larger cities that have recently adopted Service motorized street cleaning equipment. The Indianapolis Board of Public Works decided upon two 5-ton SERVICE Flushers for this heavy duty work because the Purchasing Department conferred with officials of other cities and counties using SERVICE Trucks and found that, without exception, SERVICE Trucks everywhere were making good in all kinds of municipal jobs.

The SERVICE Special Equipment Department is prepared to furnish Street Cleaning Apparatus, Fire Fighting Apparatus, Road Oilers, Winches, Hoists, Dump Bodies and other special equipment.

Write for catalog and full information mentioning size of truck and kind of equipment desired.

SERVICE MOTOR TRUCK CO., Wabash. Ind., U. S. A.

Distributors in All Principal Cities

NEW YORK
87-89 West End Avenue

CHICAGO
2617-25 So. Wabash Ave.

the "block" each engine before it can be considered O. K. for mounting in the chassis.

The engine is run on its own power under the observation of engine experts, who dectect any defects which may appear, and make adjustments necessary to perfect operation of the engine.

The Service Motor Truck Company not only makes stationary tests of each engine before it is put into the chassis, but it also applies similar principles to the testing of the whole driving mechanism of the truck. At the point in truck manufacture when some makers send their trucks out for road test Service trucks are given the "stationary" road test, which enables the expert to detect and correct any faults.

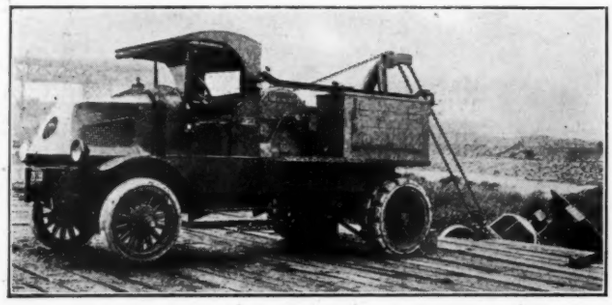
The method of the test is simple, yet efficient. The truck is driven over a pit in the concrete floor of the assembly building, until the rear wheels of the truck rest each upon a set of two larger rollers. The forward end of the lever arm, which is shown just back of the truck in the accompanying view, is fastened to the frame just over the rear axle by means of chains and wood blocks. To the other end of the lever arm an air hoist is attached, and when all is ready the hoist exerts a pull on the lever just sufficient to cause a pull-down on the frame equal to the rated load capacity of the truck. The engine is then started and the transmission thrown into gear in the usual manner of starting. The truck remains stationary and the action of the rear wheels is absorbed in revolving the rollers upon which they rest.

At this point the action of the truck is closely watched. The axles and springs are under load. The engine and driving members are working against certain resistance. Bearing adjustments are tested, alignment of the wheels is noted and brake bands are adjusted. If the axle housing gets too warm over any bearing, then something is binding, or the lubrication is not satisfactory. If a noise develops, adjustments are made. If a wheel does not run true it is removed, and many other things are noted which it would be difficult to detect when bumping along the road.

Service trucks are not considered ready for the final or road test until they have been satisfactorily "run in" on the floor of the test room. This is extra precaution which eliminates trouble beforehand and insures a greater degree of truck value to the buyer.

Garford Trucks on Highway Construction

Good roads and the motor truck may be said to be "growing up together." One is aiding in the development of the other. Modern trucks are playing a prominent part in the building and maintenance of highways throughout the country. Horse teams have been displaced entirely by the motor truck in road construction work in many localities. An accompanying photograph shows one of the latest types of semi-trailer used in hauling crushed rock for road building. The motor furnishing the power is a Garford 7-ton tractor. It is predicted that the time is not far off when every community will own and operate a fleet of motor trucks and trailers in highway and maintenance work.



MACK TRUCK EQUIPPED WITH CRANE AND WINCH.

Although it has only 700 inhabitants, the town of Barre, Vt., is setting a worthy example for larger municipalities, in the building of highways. This village recently demonstrated its enterprise by purchasing a motor truck for use in maintaining the roads in its district. The truck is a Garford 2-ton model, equipped with a steel dump body and a hydraulic hoist.

Hauling Garbage to Hogs and Hogs to Market

Richard Johnson, a farmer living near Fort Worth, Tex., bought several Federal trucks, and began buying underfed hogs in large numbers, hauling them out to his farm and fattening them on the garbage from three near-by army camps. Being paid, too, for hauling said garbage away!

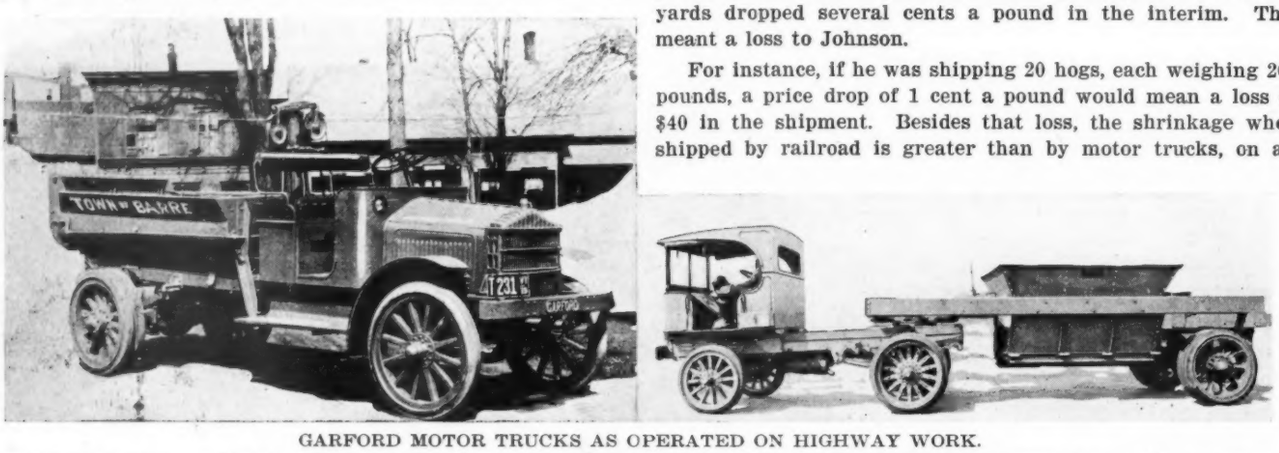
Without the use of motor trucks Johnson would probably never have entered the business, for the nearest camp was five miles away and the Fort Worth stockyards ten miles. With horses the hauls would have been too long to give any profit to the venture, either in hauling hogs to and from the stockyards, or in taking the contract for the disposal of the garbage from the camps.

The 2-ton trucks usually haul 40 lean hogs from the stockyards to the farm, and can take from 28 to 30 cans of garbage at a load. After from 60 to 100 days the hogs will average about 200 pounds apiece and then the 2-ton trucks can carry from 20 to 22 back to the yards.

Before Johnson began hauling hogs to and from the Fort Worth yards exclusively by trucks he raised some few hogs each year. These were driven over the roads in horse wagons to the Benbrook station, 2 miles from the farm. When the war broke out it was practically impossible to get cars spotted at the cattle chutes there without serious delay.

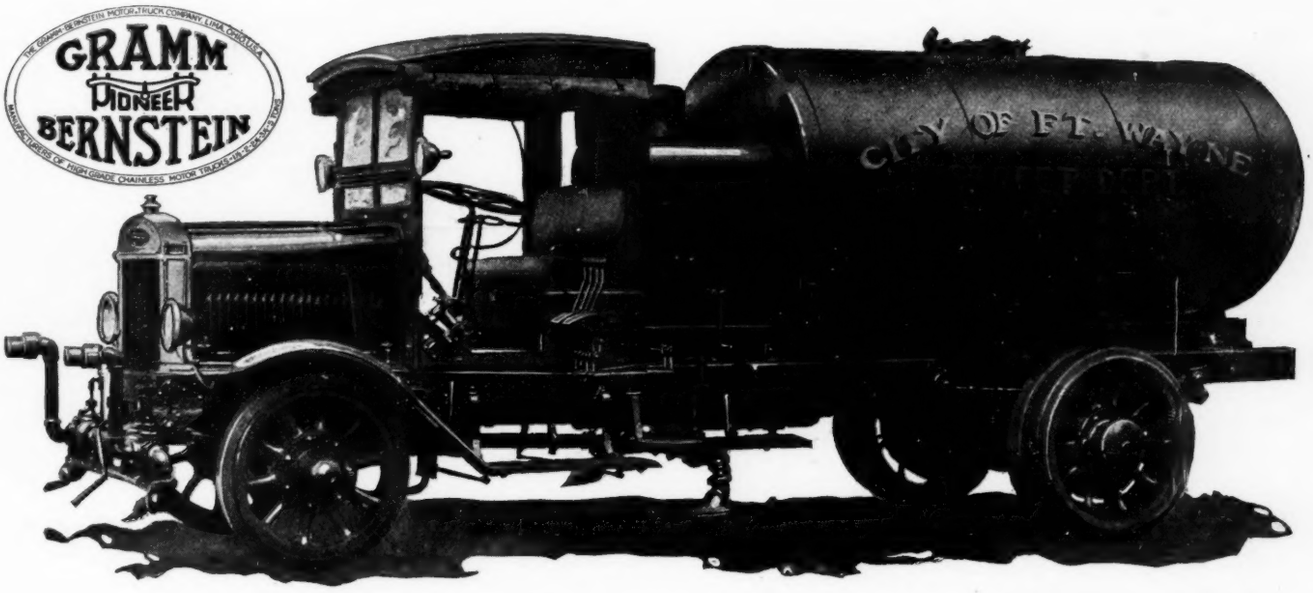
As a result the hogs had to be held on the farm for longer periods, and in some cases the market price paid at the stockyards dropped several cents a pound in the interim. This meant a loss to Johnson.

For instance, if he was shipping 20 hogs, each weighing 200 pounds, a price drop of 1 cent a pound would mean a loss of $40 in the shipment. Besides that loss, the shrinkage when shipped by railroad is greater than by motor trucks, on ac-



GARFORD MOTOR TRUCKS AS OPERATED ON HIGHWAY WORK.

Left: Garford 2-ton Model, with Steel Dump Body and Hydraulic Hoist, as operated by Village of Barre, Vt. Right: Garford 7-ton Tractor Furnishing Power for Semi-Trailer in Hauling Crushed Stone.



No Driver, No Hard Work, Can Harm This Transmission

The Gramm-Bernstein transmission of today—completely trouble-proof—is the result of a conclusion reached by B. A. Gramm, eight years ago.

That conclusion was that the transmission is the real heart of the truck—the very root of truck service.

Mr. Gramm determined to eliminate the sources of trouble which were then, and are now, common to ordinary truck transmissions. He did so with gears that are always in mesh—whose teeth can never be ground, chipped or broken by the impact of shifting.

This transmission has saved thousands of dollars for Gramm-Bernstein owners in repairs and replacements.

It is actually a basic superiority. *It is absolutely proof against every injury that might be inflicted by careless driving or hard usage.*

No driver can possibly damage Gramm-Bernstein gears in changing speed.

Simply because the gears themselves are never shifted. They are always in mesh. Speed changes are made by shifting patented dog clutches.

No part of the gear assembly can work loose, fall out, and possibly damage the entire set. That is impossible, since all gears, bearings, and dog clutches are mounted on a heavy six-spline shaft, and can never get out of alignment.

No pin, bolt, nut, set-screw, stud, or key is used to hold the gears in place on the splined shaft shown.

Literally, there is nothing in the Gramm-Bernstein transmission which can work loose and cause trouble.

Every truck in the worm-drive Gramm-Bernstein Pioneer line carries this wonderful transmission.

Mr. Gramm pioneered the truck industry eighteen years ago.

Gramm-Bernstein again pioneered with this transmission, which is proof against every trouble, from without and within.

Now, for the third time, Gramm-Bernstein leads the way by selling its trucks completely equipped, ready for the body, and with not an extra to buy.

In most cases this means a very considerable initial saving.

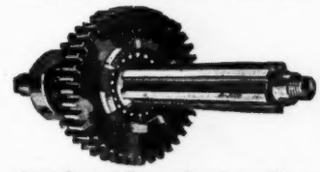
All worm-drive Gramm-Bernstein models—2, 2½, 3½ and 5-ton—are sold at a flat price, including all equipment and ready for the body suited to the buyer's requirements.

Splined Shaft, with collar and splines integral

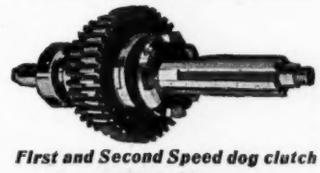
Double row annular bearing

Patented dog clutch for reverse

Reverse Gear, showing roller cage

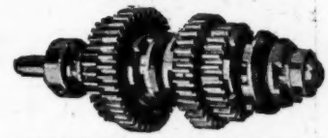


First Speed Gear, showing rollers



First and Second Speed dog clutch

Second Speed Gear



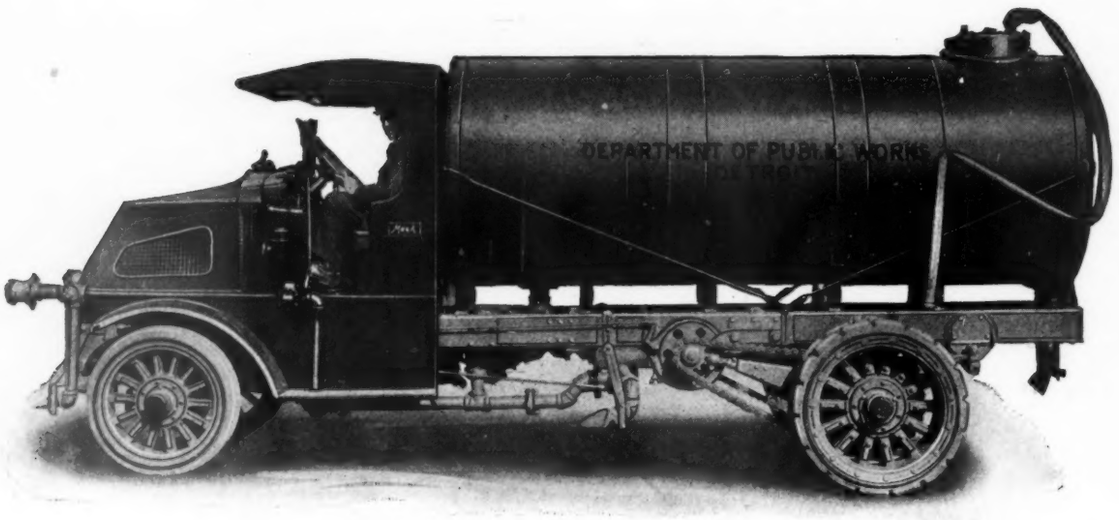
Third Speed Gear with high speed clutch and end pilot bearing, locked with castellated nut

Showing the progressive assembly of the Gramm-Bernstein Trouble-proof Transmission

All Gramm-Bernstein Transmissions are provided with a pad for attaching Gramm's Basic Patent Power Take-off. Dealers and truck owners should assure themselves that any trucks purchased with power take-off do not infringe B. A. Gramm's Basic Patent No. 1194994.

The Gramm-Bernstein Motor Truck Co., Lima, Ohio, U. S. A.

Pioneers since 1901—Builders of the First Liberty (U. S. A.) Truck.



MACK MOTOR FLUSHER AS OPERATED BY THE DEPARTMENT OF PUBLIC WORKS, DETROIT, MICH.

count of the severe jolting which the hogs receive during the train rides.

Thus, even though the cost of hauling hogs by trucks is greater than by rail, considering the 100-lb. rate, the saving effected by the quick delivery and the decreased amount of shrinkage in the end makes the truck transportation more economical and more certain. That's why Johnson is now operating five trucks in spite of the road conditions over which they travel.

Pneumatic Truck Tires Solve the Problem of Transporting Eggs Over Rough Roads

How the motor truck has solved the knotty transportation problem of the Nevada mountains is described as follows by M. L. Pulcher, vice president and general manager of the Federal Motor Truck Company, of Detroit, Mich.:

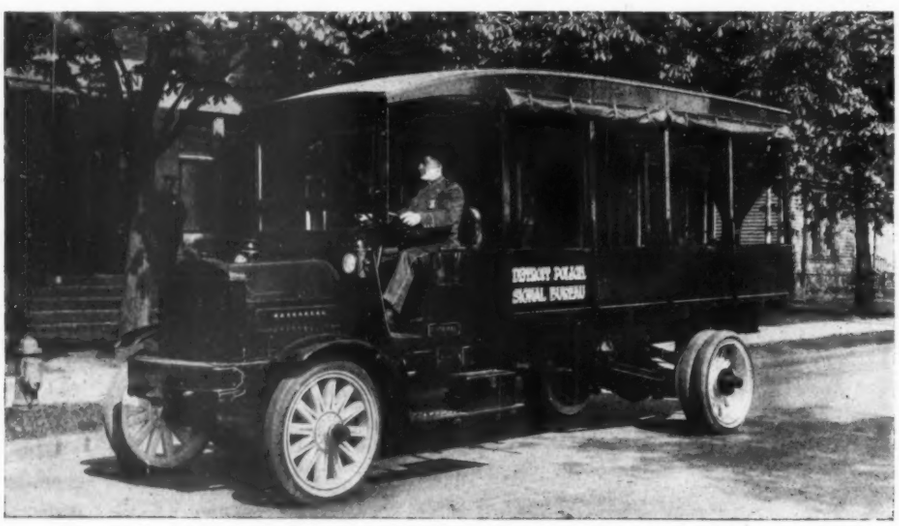
This country, which includes the counties of Washoe, Ormsby and Douglas, in Nevada, and Mono county, of California, has few highways worthy of the name. Most of the roads are merely trails leading over snow-capped mountain tops, and transportation conditions are about as difficult as poor roads and steep grades can make them. This territory is covered by the Ginocchio Bros. freight line between Reno and Gardnerville, Nev., and various other points in California.

Four years ago the Railroad Commission granted L. J. Ginocchio a franchise to operate a truck in freight transport work from Reno to Gardnerville. He put a 2-ton Federal to work and soon found he had all the business he could handle—and more. General merchandise formed the bulk of the freight from Reno to Gardnerville, and on the return trips grain, flour and produce of all kinds were carried. One round trip was made each day, requiring less than 7 hours to travel the 104 miles, although extra time was required for loading and unloading.

The business outgrew one truck, and soon Jack Ginocchio purchased a Federal and joined his brother, and the two brothers found an opportunity to extend their territory as far as Mono county, in California. Four more trucks were added, and now the five trucks are kept busy making the 104-mile trip daily. One of the trips is into the Yosemite Park, high above the famous Yosemite Valley, at the Tioga Pass, reaching rapidly an elevation of 10,000 ft. and descending over 6,000 ft., in a distance of 8 miles. On this trip salt is hauled for the cattle.

The story is told of how the young and struggling freight line met a temporary Waterloo when it endeavored to haul eggs from farm or country stores to Reno, but because of the rough roads and solid tires used so many were broken that this business was found decidedly unprofitable. A solution to the problem was found in pneumatic tires, however, and since their adoption the Ginocchio Bros. have never had to pay for broken eggs.

The Federal, on solid tires, averaged 6½ miles to the gallon of gas, but the same Federal on pneumatics traveled 11 miles to the gallon. After 3,000 miles with no trouble the tires still



FEDERAL 3½-TON TRUCK AS OPERATED BY THE SIGNAL BUREAU OF DETROIT, MICH., POLICE DEPARTMENT.

Why Fleet Owners Are Standardizing Their Equipment With Kissel Trucks

By George A. Kissel

Because present and future truck owners of America want practical and not theoretical facts—I picked at random three Kissel fleet owners among a great number and asked them to tell you their experience.

"Reduces our repair expenses"

Turner Moving & Storage Co., Denver

Mr. Turner, the President, states that standardizing on 14 Kissel Trucks gave the following results:

1—Mechanical men quickly became familiar with Kissel construction and mechanical features, facilitating adjustments and repairs.

2—Drivers preferred the Kissel to other makes, creating delays and dissatisfaction. Where there is no choice it makes it easier to secure and satisfy good drivers.

3—In two years of Kissel truck ownership, purchases of repair parts have averaged $2.35 per month per truck and would have averaged $1.00 per month per truck if we had not become stalled in a snowdrift last winter.

"Saves 270 gallons of gas weekly"

Universal Cartage Co., Milwaukee

Mr. John Vander Heyden, the president, states:

1—Since standardizing on our nine Kissel Trucks we have reduced our stock of parts over one half and have reduced gasoline consumption from 10 gallons to 5 gallons per truck per ten hour day.

2—Drivers find it much easier to work because they are capable of driving and handling any one of our models.

3—Service mechanics do more and better work on Kissels because they are not complicated — quickly becoming familiar with every part.

4—As our older trucks wear out, the interchangeability of parts permits our using the unworn parts, such as wheels, frame, springs, etc., effecting a big saving in a period of years.

"Saves 25% in upkeep"

Michener Transportation Co., Casper, Wyo.

Mr. Michener, the President, states that since standardizing on nine Kissels:

1—Not only have we cut the cost of upkeep considerably, but our trucks are making more trips. We carry a much smaller line of parts and our mechanics get out the work much faster.

2—If every owner of two or more trucks will standardize on one make, he can make a saving the first three years of 10% to 25% in cost of upkeep and operation expense.

Results of Standardizing

A summary of results from standardizing equipment with Kissel Trucks proves that:

1—Increases driver's efficiency and creates a desire on his part to handle his truck 100 per cent. Attracts good drivers and keeps them satisfied as they all have the same make of truck.

2—Mechanics and service men can concentrate on one type of construction, quickly becoming familiar with all mechanical features — eliminating delays in adjustments and repairs—saving time in changing equipment. No mechanic can make a record or show his employer that he is efficient and ambitious where he has to make the different kinds of repairs and adjustments common with a fleet of different makes.

3—Through interchangeability of parts, it permits a complete stock at small investment—reducing overhead and labor expense.

4—Enables owners to keep accurate check on gasoline, oil, tires and depreciation. If one driver can make a mileage record, other drivers can do likewise as trucks are all same make.

5—Lower upkeep and repair expense per truck per week results where entire organization is thoroughly familiar with one make. No scattering of efforts—no doing anything twice because of different design.

6—A yearly labor saving of from 10% to 40% that otherwise would be spent in divided efforts. Time and labor saved through concentrating on one make permits trucks making more trips.

7—Another important advantage is that the Kissel engineers in designing the Kissel-built motor and other units, standardized them as far as engineering principles and different sized models permitted, thus making different items oversize on the smaller models and fully equal to all requirements on the larger jobs.

8—The All-Year Cab, an exclusive Kissel truck feature, insures Kissel fleet owners uninterrupted transportation the year round—giving full protection to drivers and increased results to owners. In winter it is completely closed—snow, rain and cold proof.

Standardizing on Different Sized Units

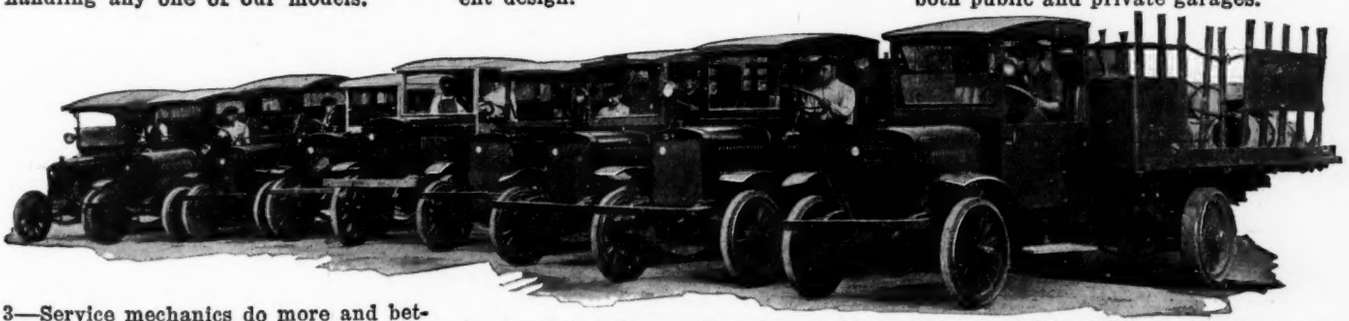
It is just as necessary to standardize on the proper sized models as it is to standardize on one make. In standardizing on Kissel Trucks, owners can choose from 5 different sized models so that each unit of the fleet will fit different requirements, thus eliminating the waste caused by employing trucks that are over-sized or under-sized for the work.

For example, one of the largest dairy concerns south of New York City uses its six Kissel "General Utility" 1½ ton models for rapid door-to-door delivery in the city, as well as auxiliary trucks for their heavier models. Their two Kissel "Freighter" 2-ton models are used to transport heavier loads greater distances, while their Kissel "Heavy Duty" 3½ ton model acts as the "Mother Ship," carrying wholesale loads great distances to where it acts as a supply base for the smaller models.

The new ¾ ton "General Delivery" Model is employed as a "Scout Runner"—a job built to carry capacity loads at a speedy rate. The biggest Kissel model—the "Goliath" 5-ton model—is easily "boss of the road."

From the Mechanic's and Driver's Standpoint

The exclusive Kissel design and construction not only minimize repairs and adjustments, but give accessibility that makes service work simplicity itself. This ease of keeping Kissel Trucks in perfect order is responsible for unusually low upkeep and overhead expense in both public and private garages.



Drivers of Kissel Trucks have not only made unusual economy records, but the functioning of the Kissel-built motor and other Kissel features gives them a pride in their work that reacts to the benefit of employer and employee alike.

The success of Kissel Trucks among the country's prominent fleet owners warrants your careful investigation. We would like to go into this subject more fully with present and prospective fleet owners as well as owners of single units, for they are the fleet owners of tomorrow.

Your nearest Kissel dealer is fully prepared to take the witness stand and submit to your cross examination. Or your request directed to the factory will bring latest literature and data. Why not send for it? Kissel Motor Car Co., Hartford, Wis., U. S. A.

look practically new. In fact, Mr. Ginocchio says the pneumatic tires have paid for themselves in business increase alone. They have done $900 more business in three months with the truck on pneumatics than with solids, and this is just a little more than the tires cost.

This enterprising Nevada firm transacts its business in the right way, care being taken to insure satisfaction to all. When

ONE OF TWO FEDERAL FLUSHERS OPERATED BY OTTAWA, ONTARIO, REPLACING TEN TEAMS AND DOING BETTER WORK.

the goods are received for shipment a way bill is made out, showing articles, value, from whom received, address, destination, weight, expense, charges, whether collect or prepaid, and when goods are delivered a space is reserved for the signature of the party receiving the shipment.

Prospective Railway Congestion Calls Attention to Highway Motor Transportation

The possibility of another period of railroad transportation congestion is once more bringing motor transportation over the public highway to the attention of the public, says the Federal Highway Council.

While it is admitted that the railways must necessarily form the nation's long distance transportation lines, the auxiliary power of the public road, through the development of the gasoline engine and the motor vehicle, is receiving thoughtful attention in official circles.

Public discussion of high cost problems and the railway situation ran into the country road at two points during recent days. The first point touched was that the public highway is a potential short haul freight and express line, and that with a national system of improved roads, intersecting each state north, south, east and west, there will thus be constructed the basis of a comprehensive, nation-wide system of traffic arteries with which state and county systems may connect. With such a system provided, the development of freight and express transportation is anticipated far beyond comprehension. Its advocates assert that the motor truck as it appears on the public highway today is but an infant compared to what it will be, once the public roads are built to permit its enlarged use.

Those who doubt the possibilities of the highway freight and express as factors in the reduction and stabilizing of food costs are told to look back over the development of the railway and note that the beginning was upon a basis far less promising as a practical proposition than the basis upon which the gasoline driven vehicle stands today.

Dropping back to the point of short haul delivery, attention is being called to the fact that the radius of highway shipping is being gradually extended as modern roads are being built. Advocates of a national highway system, the creation of which is provided for in the Townsend bill now pending in congress, have encountered the argument that approximately 50 miles is the maximum of motor delivery. Their answer is that while this may be true, it is true only at the present time because of the illogical connections and the general condition of the road.

The same economic conditions which forced railway development is forcing a national development of the public highway, and the advocates of a national highway system assert that each day's discussion of the present economic situation produces additional reasons why the federal government must get down to highway building on a nation-wide scale and in dead earnest.

In a sense, the legislative mind at Washington seems to be approaching the present phase of economic problems somewhat in a spirit of weariness. "Will we ever get anything really finished?" is a question which seems to express their feelings, since so many problems, like the proverbial cat, keep coming back.

But one fact seems to be making itself very clear, and that is that since the public highway is the first lap between the producer and consumer, the logical place to begin cutting down living costs is by eliminating permanently the time-consuming and fuel-wasting roads. To accomplish this purpose, the construction of a national highway system as a necessary and logical connection with state and county systems is being looked upon with increased favor.

Garford Company Announces New 1¼ Ton Truck

The Garford Motor Truck Company of Lima, Ohio, announces the addition of a ton-and-a-quarter truck to its extensive line. It is to be known officially as Model 25. This latest Garford development is described as having ample wheel base and body space and is claimed to be the "huskiest" model of its capacity produced to date. Provision has been made for the installation of electric lights and an electric starter.

The engine, of 22 h.p., S. A. E. rating, has four cylinders, 3¾ x 5⅛ ins. cast in one block, with heads and valve chambers integral. The valves are large and ample water jacketing is provided. With the valve location on the right side and the carburetor on the left, the gas passes through a water-jacketed section of the cylinder.

SALT LAKE CITY SAVES $68.50 EVERY DAY WITH THIS FEDERAL FLUSHER.

The engine is of sturdy design, employing a heavy crank shaft of the three-bearing type, and cast iron upper and lower crank cases. The fly-wheel is enclosed in a housing integral with the crank case.

The pistons of gray iron are provided with three concentric, tested compression rings. The pistons and connecting rods are of unusual length and the piston sweep is practically con-

fined to the cylinder bore. Only a very small portion protrudes below the cylinder base when at dead center.

The timing train is limited to three gears. This accounts in part for the quietness of operation which is characteristic of this model. The magnetic drive gear shaft is extended forward of the gear panel to drive the centrifugal water pump. When electrical equipment is required the magneto is driven in tandem with the generator, thereby eliminating the necessity of chains for this unit. The timing gears, which operate in oil, are helical in form and of very broad face. The crank shaft and four long rod bearings are of the bronze-shell, babbit-lined type. The upper rod bearings are hard bronze.

The oiling is of the constant level splash system. A gear pump driven by the cam shaft circulates oil through a steel tube system to the main shaft bearings, the overflow oiling the piston and cylinder. Lower rod bearings are oiled by splashers dipping into troughs filled by a feed from the gear pump. Ignition both on the standard and the electrically equipped models is by straight, high-tension magneto. The magneto is controlled from the steering column. The spark plugs are located over the inlet valves. Carburetion is obtained through a Stromberg one-inch float-feed carburetor. The throttle control is by foot acceleration as well as by hand throttle from the steering column.

The clutch is of the multiple dry-disc, ball-bearing type, enclosed in a housing attached to the fly-wheel case. The transmission is a three-speed selective type with all gears and shafts constructed of 3½ per cent. nickel steel, double heat-treated. The shafts are mounted on roller bearings throughout. The gear and shaft rods are on top the transmission case. As in all other Garford models the case is supported at three points.

The design of the Model 25 is characterized by its heavy shafts and large bearings. It provides for direct attachment of a power tire pump. The front drive shaft employs a pair of composition discs. The drive is tubular, requiring no lubrication and eliminating the possibilities of grinding and rattle. The rear drive is of Spicer make, all steel, grease tight and dust proof.

The front axle, of Garford design, is manufactured in its entirety in the Garford plant. It embodies a single piece drop-forging for the load carrying member and nickel steel knuckles. Oversize knuckle pins and a spherical seated ball-thrust, mark this axle as unusual for a 1¼ ton model.

The Model 25, virtually a ton-and-a-quarter truck, embodies characteristics of strength obtainable in a truck of 1½ ton capacity. It has a 1½ ton rear axle and a 1½ ton frame, with a transmission of same type.

The housing of the rear axle (a worm-drive type) is of one piece, thereby eliminating the liability of leaky joints and stretched bolts. The axle shafts are 2⅝ ins. diameter at the bearing and have a splined fit in the differential. Timken bearings are used both at the wheels and differential.

The differential is of the bevel type. Combined with the worm-carrier it may be removed from the axle as a unit. The worm is of hardened steel, the mating gear of bronze.

There are two independent sets of brakes operating on the rear wheels. Brake control is conventional in that one set of brakes is operated by pedal, the other by hand lever. Both braking systems have equalizers. Brake shoes, levers, drums and operating parts are unusually heavy, corresponding in size to most 2-ton equipment. Radiator is of the heavy truck pattern. Upper and lower water tanks of cast-iron are bolted to the vertical, finned tube, copper core. The radiator is mounted on a cushion suspension.

Steering is by screw and nut—an irreversible combination. The hand wheel is 20 ins. in diameter and has a notched

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Mayors
City Clerks

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Presidents of Boards of County Commissioners
County Clerks

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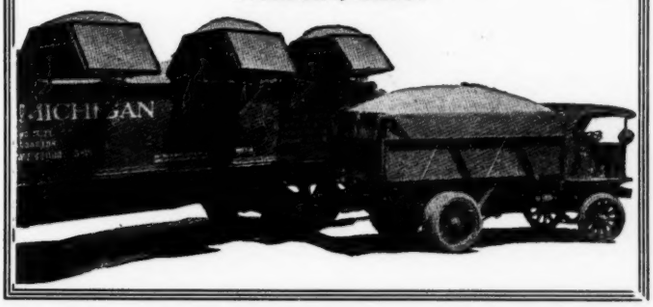


rim. It is of the five-arm malleable spider type. The entire gear is unusually rugged for a 1¼ ton truck.

Gasoline is fed by gravity to the carburetor. The welded steel tank, located under the seat, has a capacity of 20 gals. A combined strainer and shut-off, attached directly to the tank, is employed in feeding the gas.

Front and rear springs are of the semi-elliptic pattern, with leaves of Chrome Vanadium steel. The former are 42 x 2¼ ins. with eight leaves, the latter 50 x 2½ ins., with eight leaves. The spring shackles are of drop-forged, heat-treated steel. Lubrication of the shackle pins is by oil feed.

The frame of 7/32 in. stock has a depth of 5 ins., and a width of 2½ ins. It is of pressed steel construction and has six pressed-steel, channel-section cross members. All connections as well as brackets are hot-riveted. Front and rear wheels are of wood, with the S. A. E. standard felloe bands.

The standard tire equipment is of the solid pressed-on type. The front tires are 36 x 3½ ins.; the rear 36 x 4 ins. Pneumatic tires, which are particularly adapted to this new model, come as extra equipment. The curved steel dash and seat box are included as standard equipment with the chassis. These units are of high quality wood with a covering of heavy gauge body steel.

The control is standard with the steering wheel at the left and the brake and the clutch at the center of the chassis. The spark is controlled from the steering column.

The lamp equipment includes two side oil lamps mounted flush in the dash—a special feature—and one rear signal oil lamp. The seat is extra wide and carries three persons comfortably.

A special effort has been made to standardize the Model 25 throughout with the result that odd wrenches and spanners are not required. A full set of tools is included in the price of the chassis which is quoted at $1,890 f. o. b., Lima, Ohio. Pneumatic cord tires, 36 x 6 ins., all around, a power tire pump and extra rim, are furnished at $285 extra. Electric lighting and starting may be had for $125 extra.

Views of a Motor Truck Manufacturer on Restrictions on Highway Transportation and Causes of Damage to Highways

By R. E. Fulton, Vice President International Motor Co., New York, N. Y.

Causes of Damage to Highways

There seems to be a tendency on the part of some who have not thought deeply on the subject to foster the idea that the only wear to roads comes from the use of the motor truck. A few years ago the automobile met with this condemnation, but the automobile is now a thing of such common use that hardly anyone finds fault with it any more.

The motor truck is rapidly becoming the nation's freight carrier, and while it is not true there are people who believe it comes in direct competition with existing means of transportation of supplies, especially in rural communities and between cities.

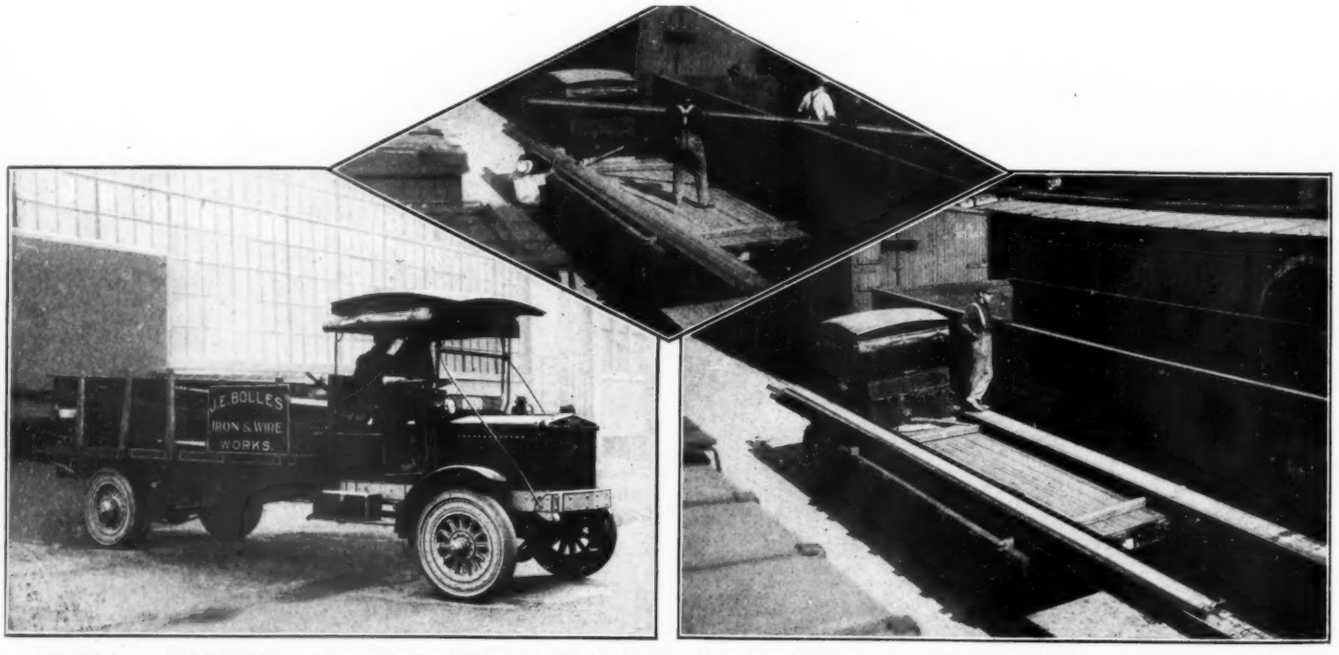
There has been some unwise legislation against motor trucks as a result of such an attitude. But with motor trucks hauling more than 350,000,000 tons of farm products a year, the people can hardly sit idly by and allow legislation based on false ideas to hit at the very source of their life supply. Of all vehicles using our highways, the motor truck probably causes the least damage in proportion to the service it renders.

There are two things that cause damage to roads; one is the impact of weight; the other is wear to the surface. With a substantial roadbed the impact of weight does little damage. If the roadbed is faulty, weight tends to break it. It is simply a matter of gravity.

Perhaps the greatest destroyer of road surfaces and the least condemned is the steel tire. The steel tire hits the roadway with an absolutely ungiving impact. Its constant hammering crushes stones and shatters all particles that project from the surface of the road.

Steel tires are usually narrow and they wear and cut deep tracks and ruts. They pulverize the surface, so that automobiles, with the suction of their pneumatic tires, suck up the dust that is formed and scatter it to the winds.

The motor truck with its broad flat rubber tires and slow



FEDERAL 3½-TON TRUCK BUILT ESPECIALLY FOR HANDLING LONG SECTIONS OF STRUCTURAL IRON, AS OPERATED BY J. E. BOLLES IRON & WIRE WORKS, DETROIT, MICH.

speed, compared with that of the automobile, causes practically no damage to the surface of the road. It causes no abrasion and there is no suction from the solid tires. Of all traffic on the highways the motor truck does the least damage to the surface of the road.

As to the weight it imposes upon the highway, this is largely taken care of by the 800-lb. limit per inch of tire width. Legislation which arbitrarily limits the carrying capacity of motor trucks simply adds to the cost of transportation and increases the cost of living.

It is for the people to insist that legislation governing motor trucks be intelligently formulated. As the use of the motor truck becomes more and more an every day matter, much of the hostility manifested at this time will be completely overcome.

Shall Restrictions on Transportation be Permitted to Limit Development?

With the constantly increasing volume of transportation upon our highways, the problem is one which will have to be met with the development of the future in mind, as well as the needs of today. There is only one thing we can assume as absolutely certain, and that is, the amount of transportation will continue to increase at an enormous rate every year.

The problem before us is primarily neither good roads nor motor trucks, but how shall we handle the enormous volume of traffic that is increasing every year at a tremendous rate?

In meeting this problem, we must keep in mind first of all that transportation must be cared for; we cannot reduce it or abolish it. We have got to build our roads up to the demands made upon them by the needs of the people. We can not permit progress to be strangled by inadequate transportation facilities.

From an economic standpoint, the development of highway transportation lies in the use of larger capacity units, and not in limitations to smaller vehicles. If transportation efficiency is to be the standard, our highways must be constructed or rebuilt to carry satisfactorily heavy motor trucks of even larger capacity than the largest now in use.

It is not difficult to picture the economic handicap to railroad transportation, and with it the curtailment of the wonderful development of this country, if the railroads had been forced to adhere to the 40-lb. rail, instead of advancing steadily to the 70-lb., the 80-lb. and 90-lb. rails, which make possible the huge and powerful locomotives and heavy trains now in use. The only difference in the situation is that the roads are publicly owned, while the railroads are privately owned.

In the matter of initial cost of motor trucks, there is a marked gain in economy with the larger capacities. The cost per ton capacity in the case of the average half ton truck is $2,028; for the 3-ton capacity vehicle, $1,322, and for the 7½-tonner, $740. There is no doubt that the ratio of increased economy will hold for sizes up to at least 10 and 12-ton capacity trucks.

In the operation of trucks, we find increasing economy on the per ton load capacity basis, not in a few or even a group of items, but in practically every charge coming under the head of operating cost, from fuel to depreciation, and from driver's wages to insurance. Where large units can be used they materially decrease the ton-mile cost of transportation.

Comparing the 2-ton capacity truck with the 5-ton capacity, we find that in increasing the load carried 150 per cent., the operating cost is decreased 18.2 percent.; while comparing the 3-tonner with the 7½-tonner, there is also a 150 per cent. increase in carrying capacity with a decrease of 22.8 per cent. in operating costs. Unquestionably, this ratio will hold good for much larger sizes, so maximum transportation efficiency in motor transportation must be sought in vehicles with carrying capacity greatly beyond the largest in use today.

In view of these facts, our highways should be built to stand the amount of traffic that is demanded of them. Limiting the gross weight of any vehicle to less than 28,000 lbs., is short-sighted economy for the present that is storing up a large amount of trouble and expense for the future. Roads must be built to meet the requirements, for the requirements cannot be limited to road conditions.

Some Observations on the Field For and Use of Materials Handling Equipment

By J. M. Van Harlingen, Transportation Engineer, 41 Park Row, New York, N. Y.

We may figure that every man saved from the work of man-handling merchandise or factory products, effects a saving in money value of $800 per year, which is the interest on a little more than $13,000, said Mr. Van Harlingen in addressing the Material Handling Machinery Manufacturers' Association. I do not believe that this particular form of argument is often presented to a prospective customer by the salesmen of materials handling equipment. Certainly, in my experience, no salesman has ever placed the subject before me in just this light. In the case of materials handling equipment, the buyer is, nine times out of ten, convinced of the necessity for a certain type of machine, before the salesman starts to talk, and it is to this class of buyers, for the most part, that factory equipment has been sold.

I believe that in connection with the advertising of materials handling equipment, a very definite policy of instruction should be laid down for the use of salesmen. I do not mean by this that the salesmen who represent companies do not at the present time present forceful arguments for installing their equipment. There is as much opportunity, in my opinion, for the development of an educational campaign among the salesmen of materials handling equipment as there was for such educational work among the salesmen of the National Cash Register Company.

It is my belief that the best argument for the sale of equipment which is expected to result in economy and increased efficiency is a recital of the actual results of making such installations, and that these arguments should be presented before any mention is made of the cost of installation, or any arguments are presented with respect to the mechanical construction. I believe that both the advertising and the sales talk should concentrate on facts which can be substantiated by the actual experiences of satisfied customers. There is too little definite data on the saving effected by the use of materials handling equipment, and personally I should be very much more impressed with one fact than I should with several pages of estimates and expressions of general opinion.

Some six or seven years ago I was employed by a motor truck concern to develop a department for the study of economic trucking. The work which this department undertook was divided into three larger divisions.

1. The study of the field for various types of vehicular equipment, horse drawn vehicles, gasoline trucks, electric trucks and tractors.
2. The study of the methods of operating these vehicles.
3. The collection of cost data, and the analysis of the cost of operating the various lines of business.

In the course of these investigations I was very much impressed with the necessity for the economic handling of materials at loading and unloading platforms. It seemed absolutely essential if motor trucks were to be operated profitably, that the lost time for loading and unloading should be cut down to a minimum. After an absence of almost five years from the motor truck business I have returned to find, some-

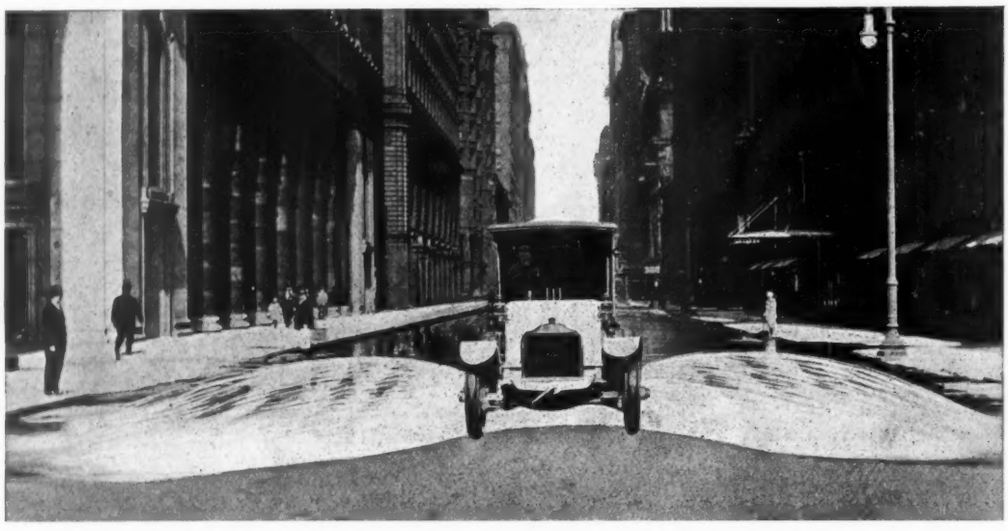
what to my astonishment, that little or no progress has been made here in New York on the handling of materials at the platforms of factories, warehouses, or transportation terminals. The territory is typical of the entire country and presents a very ripe field for the introduction of mechanical handling devices.

Generally speaking, a 3 to 5 ton truck costs about $10 per day, excluding those charges which are dependent upon the mileage, gasoline, lubricants and tires. If a truck operates, or I should say, is out of the garage ten hours a day we may estimate the cost of holding the truck idle at $1 per hour. Go along West street its full length and you will probably be able to count from two to five hundred trucks, standing waiting their turn to get at the piers. If each one of those trucks is held for one hour a day, the loss to the trucking interests is over $100,000 per year. This is a conservative figure, and I have heard the statement made by those who were familiar with the trucking situation in New York, that very few trucks are in operation more than 40 per cent. of the day. If, therefore, a truck costs $10 a day for overhead charges, $6.25 of this charge is for non-productive time. I am convinced that the adoption of mechanical equipment for loading and unloading these trucks would result in reducing this delay time, by at least 25 per cent. I do not believe that this reduction can be accomplished simply by placing this equipment on the docks, or at the warehouses. It must be watched, and those who are to use it should be carefully instructed in its proper management.

I believe that the success of all installations depends upon securing the co-operation of all parties to the end that a mutual benefit would be derived. The great stumbling block at the present time is an ignorance on the part of the higher officials managing transportation terminals and warehouses and a selfish short-sightedness on the part of the smaller officials, such as superintendents and clerks whose immediate interests and in many cases whose actual financial success depends upon a continuance of the present wasteful methods. It is easier to correct the conditions existing at warehouses and manufacturing plants where a greater degree of control may be secured, than it is at the water front and other terminals where the control is not so definite, and where the shackles of custom and habit not only embarrass the small fry, but appear to bind every official from the highest to the lowest. I have talked with hundreds of railway men, and I have known of cases where one division of the railroad has adopted a method of handling its goods which is proved to be economical, and yet the next division can not be made to adopt a similar method. Those who have had most to do with the railroads will bear me out in my opinion that there is no more difficult field to be developed than that of the railways, and when it is developed there is no field which will prove more profitable and fertile for the use of mechanical handling devices.

I passed down one of the railroad piers the other day, and, lying behind a large pile of merchandise, saw a full line of equipment. If I had been contemplating the use of this kind of equipment in my organization, and had not been familiar with the New York dock situation, I should have received an impression which it would have been the task of a salesman to overcome, if he could.

In offering these observations, the writer has attempted to put into words the impressions which have been gathered both from the angle of the user of materials handling equipment, and from the angle of the man who sells it. There is no doubt but what many will disagree radically with some of the statements which I have made, but my thoughts are very far from being theoretical. While I am very much interested in the solution of transportation and materials handling problems, and I have called myself a transportation engineer for want of a better title under which to do business, I have always tried to handle the problems which have come before me from a practical standpoint, rather than from a theoretical one. I have faced a large number of salesmen, as a buyer, and I have faced a large number of buyers as a salesman, and I believe that the most important factor in marketing a product which is essentially a means of increasing efficiency, too much stress cannot be laid on the education, first of the salesman, and second of the buying public. The advertising, and here I tread on very thin ice, because my knowledge of advertising is very slight, should be prepared with a view to co-ordinating the efforts of the salesman, in his personal instruction, with the education of the buyer, whose impression of your equipment is derived first from the printed word.



SAURER 6½-TON FLUSHER AS OPERATED BY THE CITIZENS' STREET CLEANING BUREAU, CHICAGO, SHOWING CURB TO CURB SPREAD OF FLUSH.

No. 49

This is Motor Truck Section Number Forty-nine, the first number in the **Fifth Year.**

Every month for over four years, ***Municipal and County Engineering*** has published a special Motor Truck Section, consisting of articles and advertisements of interest to truck users, truck salesmen and truck manufacturers.

Through this Motor Truck Section a very great deal has been done to demonstrate the practicability and economy of motor haulage in city and county. No other similar medium has done so much to popularize the motor truck.

For many years this has been the leading highway journal; latterly it has also been the leading motor truck journal in its field. It has pointed the way to the cooperation between motor truck and highway interests which rapidly is giving a real highway system to the country.

To reach workers in the highway field, and in every branch of the great public works field, use ***Municipal and County Engineering.***

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For forty-six years the handling of big, awkward, cumbersome loads has been a daily task in our own business.

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As Manufactured by
The LEWIS-HALL IRON WORKS
DETROIT, MICHIGAN.

EDITORIALS

Expert Builder or Business Gambler?

Is the contractor primarily an expert builder or is he a business gambler? Presumably he is an expert builder, or should be, and usually he is, perforce, a business gambler, which he should not be. In these days of change in the construction field when engineers are being registered, their salaries increased, and when it seems the millennium is near at hand, perhaps the most gratifying thing of all is that so many engineers, as well as contractors, are rebelling against the archaic lump-sum contract which forces the contractor to gamble, to bet that it will not rain, and to guarantee an owner against all manner of unknown conditions influencing construction costs and clearly beyond human control.

The contractor is a construction specialist who has the ability to build safely and economically. That is enough to expect of one man. When, as is usually the case, the contractor is also expected to pledge his private means that the cost of a piece of work will not exceed the minimum possible under the most favorable conditions, he is simply making a bet that everything, including the forces of nature, will play directly into his hands.

The newer form of contract which protects the contractor against conditions which neither he nor any other mortal can anticipate or control is not only more equitable, but is a nearer approach to the standards of fair play and of the square deal which characterize American business life. We do not mean to speak extravagantly when we call the lump sum, guessing, gambling contract a disgrace to the construction industry and the darkest page in its history.

The old form of contract is not in the interest of good public policy or of good public morals. Surely it is contrary to the best interests of the public to have a new crop of contractors each year, yet that is the condition toward which the old contract forces the industry. Because some very wise or very lucky men make large "killings" in the contracting business there are always many who are willing to enter it, cheerfully assuming the risks of the game in the hope that they will win a large profit as a prize. As in any other enterprise depending largely on chance, many lose where few win. And those who win one year may lose the next. As a learned jurist once said of another risky enterprise, the old form of contract "is an appeal to cupidity which lures to improvidence." No argument is necessary to prove that it is a bad thing for the country to have three classes of contractors, namely, those who are just breaking in, those who are still in, and those who are down and out. The transition from the first to the third class is as painful as it is rapid; only the exceptional man succeeds in maintaining his precarious foothold in the intermediate position; even then there is but little joy in his life, for he has as many things to worry about as the proverbial night watchman in a powder mill.

The old form of contract is also contrary to public morals, for it engenders a battle of wits between the contractor and the owner or the owner's agent, the engineer. The tendency on one hand is to build up to a standard, and on the other down to a price. Contractors do not claim to be better than other men, but they insist they are just as good and we think they are right. In a game of gouge they try to protect themselves and that is only natural. Any one who expects the contractor to assume all the risks and then interpret all the clauses in the contract and specifications strictly in the interest of the owner is simply ignoring the elementary impulses of human nature.

The cost-plus contract is gradually being perfected so as to afford just protection to both parties. Contracts of this class are being worked out whereunder the contractor is not expected to cope single-handed with the forces of nature and all the "slings and arrows of outrageous fortune." At the same time his earnings are proportional to the skill of his performance so that the incentive to build economically remains, while the temptation to build poorly is removed.

The Graduate Engineer

It is undoubtedly true that in every engineering organization where the services of engineers of various grades of training and experience are required there is a certain point, as the scale ascends, where the services of a graduate engineer are required. By a graduate engineer we mean, of course, a man who has actually attended and graduated from an engineering school or college, as distinguished from the graduate of a technical high school or an engineering correspondence school. It is important to note that, generally speaking, there are certain positions which cannot be successfully filled by others than graduate engineers.

In any attempt to fix equitable salary scales for engineers, where the compensation bears direct relation to the duties performed and the responsibilities assumed, recognition must be given the graduate engineer at his point of entry; that is, there should be a very substantial difference between the compensation of the highest grade of non-graduates and the lowest grade of graduates. This difference should be proportional to the cost of a college engineering education. The graduate engineer has made an investment in an expensive education on which he is entitled to an immediate return, not only in justice to him, but also as a matter of public policy, for it surely is in the interest of the public that the engineering work of the country be done by well-trained engineers. The compensation of the young graduate engineer is of great importance, for on this depends his ability and inclination to remain in the engineering profession long enough to render maximum service to the public.

It will be understood that we speak here in general terms only. It is recognized that many self-trained engineers overcome all handicaps and reach the top. These men, because of native ability and the diligence with which they continue their studies, are able to fill successfully one position after another. This is a question of ability, solely.

The entire matter is merely a question of ability. As

a rule the graduate engineer is more able than the non-graduate, and this fact should be recognized at the outset of his career. The point is stressed now because salary scales are being revised for engineers. Now is the time to give thought to this matter in fixing schedules that may be effective for years. In studying the duties pertaining to certain positions and in fixing salaries for those positions, the point of entry of the graduate engineer should be recognized. At that point there should be a sharp upward trend in the salary curve.

Remedies for an Engineering Ill

A very large number of engineers agree that the competition of engineering teachers with consulting engineers is one of the ills affecting the profession. The subject is one that has often been discussed and it must have more discussion, obviously, since it has not yet been settled right. It will be discussed here in all fairness, without prejudice or favor. The editor is friendly to all parties, not only because of his present cordial relations with engineering teachers as well as with engineers of all classes, but especially because he had some years of experience as a teacher in an engineering college and in city and consulting engineering work. This discussion is, therefore, based on personal experience and observation.

Why do teachers of engineering enter into competition with engineers in private practice? For two reasons: to gain experience and to earn money. Each reason merits further discussion.

Many engineering teachers seek outside consulting work as a side-line to their teaching so as to gain the practical experience that they must have for successful teaching. A teacher without such experience is regarded by students, as well as by others, as a mere theorist. That practical experience is an essential part of the teacher's equipment all will agree, but there is a right and wrong way and a right and wrong time to acquire such experience.

A teacher of engineering science who lacks practical experience is a misfit. He should have at least enough practical experience to command the respect of the first class he faces. He can gain additional experience during leaves of absence and during the long and numerous vacations that are such a delightful feature of academic life.

Experience should be gained by the teacher in collaboration with existing engineering organizations, not in competition with them. Such opportunities for professional work can be found by any teacher who seeks them.

When a man undertakes to run two jobs at the same time, each requiring his personal attention, either one or the other, or both, must suffer from insufficient attention at times. Where there is a conflict of interests the teaching is practically sure to be neglected. We dare say that the majority of engineering graduates can remember many occasions when their teachers, who were operating side-lines, were inaccessible to the students. This is unfair to the students, is keenly resented by them and lessens their interest in their studies. The time for outside work by teachers, then, is any time which does not belong to the educational institutions employing them.

One must sympathize with the teacher's desire to earn more money, for teachers' salaries are, in most cases, insufficient. If the teacher has great difficulty in making ends meet with his salary, it is only natural that he should seek secondary sources of income, and no amount of preaching or protesting will keep him from doing so if he is enterprising enough to get out and hustle. The remedy for this condition is to pay the teachers adequately for their teaching work and then require them to give proper attention to their collegiate duties. Practicing engineers who suffer from and deeply resent the unfair competition of teachers will do well to work for such salaries for teachers as will make them satisfied with one job at a time. State engineering societies should co-operate with the teachers of engineering in state colleges with this end in view. This can be done and should be done.

The competition of teachers with practicing engineers is, we have said, unfair competition. It is unfair to the students and to the engineers. Teachers do not have to pay office rent. They have one income, and so can cut under the prices of the engineer who depends only on his fees for a living. Some teachers who take outside work have much of the detail work done by their students at very cheap prices. The teacher has the prestige of his institution at his back, and this is a guarantee, in the eyes of prospective clients, of his integrity as well as of his ability. He has numerous unfair advantages in competing with the independent engineer. There are some teachers of engineering who go to extremes in their pursuit of practical experience and outside income. They apparently regard their teaching jobs as little more than meal tickets, depending on the outside earnings for their substantial compensation. In some localities this condition has reached scandalous proportions. In one state, at least, this unfair competition has almost ruined the practice of the consulting engineer.

The annual meetings of state engineering societies will be coming on in a few months. At those meetings this matter should be vigorously discussed and appropriate action taken. The present condition should not be allowed to continue, for it is bad for all parties.

Buried Treasure

The engineering editor's idea of buried treasure may provoke a smile, but, understand, the editor has a right to his opinion, and, fortunately, he has the opportunity to express it. Since the editor deals in engineering literature it is only natural that his idea of the treasures of earth should pertain to the great unworked deposits of raw material of this sort which are known to exist, but which remain deeply buried in the engineer's brain or in his files. It is a very tantalizing thing to know that these gems lie at the dark, unfathomed bottoms of filing cabinets in all parts of the country and that all the persuasive powers of the editor are not sufficient to draw them out for useful purposes. What a melancholy thing it is to realize that many flowers of engineering eloquence are but "born to blush unseen"!

Every month the editor goes prospecting around for these treasures. By keeping his sleeves well up at the elbow he manages to uncover a good deal of this material which assays sufficiently high to make its recovery well worth the effort involved. But always there remains regret that those who inter these treasures are so slow to exhume them.

Resurfacing Old Macadam and Gravel Roadways with Special Reference to Adaptability of Old Roadbeds as Foundation for Hot Mix Bituminous Surfaces

By Hugh W. Skidmore, Chicago Paving Laboratory, Consulting and Inspecting Engineers, 160 N. Wells St., Chicago, Ill.

While it is true that the value of old macadam, broken stone and gravel roadways as foundations for permanent pavements has been realized in some communities and is thoroughly appreciated by quite a few engineers in general, nevertheless, this valuable asset is often underestimated or entirely overlooked, with the result that an admirable foundation structure is either partially or entirely destroyed to make room for one which may not surpass the old roadbed as a foundation structure, all things considered.

General Requirements of Pavement Foundations

Before taking up the discussion of the adaptability and practicability of these old roadbeds as foundations for permanent types of surface, it is proper to point out briefly some of the requisites of a suitable foundation for pavement structures. The term is generally understood to mean a substructure upon which the wearing surface is laid, and by means of which the traffic forces are transmitted to the subgrade. When the foundation is called upon to act as an arch (or bridge) over weak sub-grade areas it ceases to function as a substructure and actually becomes a superstructure.

The character and thickness of the foundation to be employed is dependent upon three chief factors, viz., (1) the character and weight of the traffic to be carried, (2) the kind and condition of the subsoil, having in mind the natural drainage ability thereof, (3) and the type of wearing surface to be used. The first two items are of prime importance, the third permits of more latitude. The selection of surface type, is also made with reference to item number 1.

Local conditions often reveal a combination of circumstances rendering it necessary to consider a number of different factors in the selection of a suitable type of pavement surface and foundation. The relative values to be assigned to these various items will be founded upon ultimate economy; quality, sufficiency and adaptability of local materials; and the certainty of receiving bids from reputable contractors, experienced in, and properly equipped for constructing the pavement.

The pavement must first be well designed. This will require the services of a conscientious and thoroughly experienced engineer. It must then be built properly by experienced workmen in the employ of a reputable and well equipped contractor possessing a sound business organization. And last, but not least, intelligent and careful supervision must be maintained throughout the construction of the pavement. In short, the price of a good pavement may be said to be proper design, good workmanship and careful supervision intelligently and persistently applied.

While the foregoing digresses somewhat from the topic immediately under discussion, it is thought to be warranted by the fact that these points are of utmost importance and will bear much repeating.

The foundation must be able to bear up without crushing under the traffic loading. The portion of the weight which it is required to support will depend upon, (1) the type and method of construction of the wearing surface, (2) the supporting power of the sub-grade, and, (3) the ability of the foundation to maintain close contact with the sub-grade. For example, the foundation beneath a monolithic brick pavement will not be required to support the same proportion of a given load, as will a similar base under a 2 in. asphaltic concrete surface.

The foundation structure should rest upon a firm, unyielding sub-grade, reasonably well drained. The term "reasonably well drained" is used deliberately, since anything approaching absolute drainage of sub-grade in some kinds of soil will be prohibitive as to cost. Consequently, in the light of true economy it would not be considered good practice to incur the expense of an elaborate system of under-drains in some instances. Likewise, the construction of a rigid base of sufficient thickness and strength to enable it to support the heaviest loads, without the possibility of failure over a few small areas of weak sub-grade, would be false economy. In other words, it would be better engineering to specify a somewhat weaker foundation with the knowledge that the use thereof would very probably entail a small amount of repair due to foundation failures.

It has been advocated that the sub-grade be insured absolutely against the development of weak spots. Some have gone to the extreme of advocating that all sub-grade areas of doubtful stability be excavated and refilled with gravel, broken stone or lean concrete, and that a subsequent layer of gravel or broken stone be spread over the entire sub-grade area. While such elaborate procedure might have merit in extreme cases, the cost would undoubtedly be so great as to render it unjustifiable in most instances. A compromise by excavating and re-filling the insecure areas with gravel or broken stone and omitting the layer of gravel or stone, with some slight possibility of future settlement, seems a more reasonable plan. However, a soil condition which would warrant the expense of a layer of gravel or broken stone, primarily as an aid to drainage, may be readily appreciated.

The writer is inclined to feel that the ability of the foundation material to seek solid contact with the sub-grade is of more vital importance on the average paving job, than the securing of a rigid base of sufficient slab strength to carry the entire weight of traffic, and bridge over all soft spots in the sub-grade.

A foundation for bituminous surface should, in addition to supporting and load distributing power, possess certain qualities which will make for the minimizing, if not the elimination, of surface reproduction of cracks and other defects due to foundation failures, which experience has shown are practically unavoidable when concrete foundations are employed.

The foundation should by its nature and character preclude or at least minimize the amount of moisture coming in direct contact with the wearing course from beneath. This feature is not only of extreme importance with reference to bituminous surfaces, but it is also of considerable importance in considering foundation structures for other types of pavement.

Suitability of Broken Stone, Stone and Gravel Macadam Pavements as Foundations for Permanent Types of Surface

Almost innumerable examples may be cited of stone and gravel foundations which have given high-class service for many years. While no attempt is made here to enumerate any quantity of specific cases, the service records of this type of foundation furnish ample proof that they have usually surpassed the average cement concrete base, so far as general compliance with foundation requirements and moderate maintenance expense are concerned.

Salient Features of Design for Street and Highway Resurfacing—Drainage

Before taking up the discussion of practical methods of preparing the old pavement for use as a foundation, it is desirable to point out and briefly discuss some of the more important features of design peculiar to city streets and country highways. Since reasonably good drainage is of fundamental importance it should be one of the first items to be considered in designing any pavement structure. On country roads drainage is usually secured by means of side ditches. These ditches should be deep enough and wide enough that their effectiveness be not impaired by the growth of vegetation. They should also have sufficient fall and frequent outlets in order that the run-off during storms may be as rapid as practicable. The depth, width and gradient of these ditches will naturally depend to a large extent upon the porosity of the

HEAVY TRAFFIC HIGHWAY RESURFACED WITH ASPHALTIC CONCRETE. FAILURE TO PROVIDE EDGING OR CURB PERMITTED LATERAL DISPLACEMENT WITH RESULT SHOWN. SUCH FAILURES NOT DUE TO TYPE OF PAVEMENT BUT TO POOR ENGINEERING.

soil, the extent and shape of the drainage area and the frequency of available outlets. The recommended minimum depth below the crown of the pavement is 3 ft., the minimum width at the bottom can be safely established at about 24 ins.

Side ditches should not be allowed to become choked, nor should they be built with low velocity gradients that will cause them to run full for any great length of time, since such a condition will be naturally conducive to excessive saturation of the sub-grade and foundation.

Special provision should be made for drainage of the roadbed across marshy land, through cuts which are inclined to be wet, across flat land which has a high water level during the wet season, and at the foot of rising grades. Sub-surface drainage may be accomplished in several different ways; lateral tile drains discharging into the side ditches will ordinarily be sufficient through cuts and in wet areas of limited extent. Across marshy land or areas on which water stands during the wet season, the pavement should be built up on broken stone, boulders, or some similar type of sub-base construction; the object being to raise the pavement well above the normal saturation level by means of some stable sub-foundation construction. In such cases a Telford or similar base will prove very effective.

Since all of the water which is liable to cause trouble comes from without the pavement, it is highly essential that this water be adequately intercepted and promptly removed. This is equally true of both highway and street pavement construction. A system of intercepting drains as indicated on an accompanying sketch with laterals topping portions of the sub-grade which are inclined to be unstable or poorly drained, will be found to be the most effective for city streets. The necessity of such drainage should be carefully gone into before the expense of construction is incurred, remembering that disaster usually follows when inadequate drainage facilities exist. It is very probably true that at least 75 per cent. of pavement ills may be traced directly or indirectly to lack of proper drainage.

Width of Roadway

In considering the problem of resurfacing of highways, the width of the old roadbed may have more or less weight in determining the width of the new pavement. When assigning a value to this item as affecting the pavement width, it should be remembered that the general tendency is to build pavements too narrow rather than too wide. Country roads should never be of less width than certain well established minimums, such as 10 ft. for a single line of traffic and 18 ft. for two lines. In fact, 12 ft., 20 ft., and 30 ft. are considered good practice for one, two and three lines of traffic, respectively.

When narrow pavement widths are used, substantial shoulders at least 4 or 5 ft. wide, with an earth berm of 3 or 4 ft. width between the shoulder and the ditch are advisable. When the wider pavements are specified, the width of shoulder and berm may be decreased somewhat; however, if the side ditches are likely to prove a source of danger on account of their depth, ample shoulder and berm space should be allowed between pavement edge and ditch.

Provision for ample width of pavement is especially important on country roads. When a bituminous wearing surface is specified without some sort of substantial edging, the pavement width should be increased 3 or 4 ft., as experience has shown that where 18 and 20 ft. roads are built without substantial curbs, vehicles are crowded over to the outer edge of the pavement, invariably causing a breaking down of the unprotected edge of the bituminous mixture. There are likewise many examples of broken curb and fractured concrete

TWO-INCH ASPHALTIC CONCRETE LAID OVER OLD MACADAM 3½ YEARS AGO. OLD ROADBED CUT DOWN AT SIDES AND BUILT UP AT CROWN. PAVEMENT IN PERFECT CONDITION.

foundation resulting from the same source, on heavy traffic highways of insufficient width. The ultimate economy of any additional expense in providing ample pavement width will be readily apparent.

When hot mix bituminous resurfacing is selected, bituminous concrete naturally suggests itself as a most suitable material for widening the roadway. While other material may be used for this purpose, the use of bituminous concrete or bituminous macadam will save in time of construction, and will not only possess all the advantages of a bituminous base, but may also be so laid that curbing or edging may be dispensed with. When the width of the extension equals 4 ft.

or more cement concrete may be used; the use of concrete for narrower strips not being available owing to its susceptibility to lateral displacement under such conditions. Broken stone or macadam may also be used for extending the foundation, but is not recommended, except for very narrow strips, unless it is found practicable to open the road to traffic for several months. The accompanying half-sections are intended to convey some suggestions of practical methods of increasing the width of old highway pavements.

Thickness of Base

While it is true that an old macadam or gravel pavement may be of considerable worth as a foundation even though it be so badly worn that it is of practically no value as a pavement, it is also true that the resurfacing of an old road

CRACK AND UPHEAVAL OF CEMENT CONCRETE FOUNDATION UNDER ASPHALTIC CONCRETE PAVEMENT, A COMMON RESULT OF THIS TYPE OF CONSTRUCTION.

is often so long delayed that its potentialities in this direction are greatly reduced or practically destroyed—the moral to be drawn from this fact being obvious. Therefore, before advancing very far with plans for resurfacing a pavement which is in bad condition generally, or of which there may be doubt as to the depth of existing material, a sufficient number of test holes must be made to determine fairly the average depth of old metal. This knowledge may very properly be the determining factor in deciding upon the depth and character of new material to be added to the old pavement.

Naturally, local soil and traffic conditions and the type of wearing course will determine the allowable thickness of base, so that no hard and fast rules may be laid down. But, in a general way, we may establish working minimum depths of old material which will preclude the necessity of adding fresh material, providing the surface is of fairly uniform contour. Depressions 2 ins. or more in depth should be brought to grade with fresh material before the top course is applied. For residence streets or country roads having moderate traffic the minimum foundation depth should be 6 ins.—preferably the material should show an average minimum depth of 6 ins. at the sides and 8 ins. at the crown; for fairly heavy or fairly dense traffic these minimum depths should be increased from 2 to 3 ins.; and for heavy or very dense traffic 10 ins. at sides and 12 ins. at the center will be none too much. These depths are intended to cover the final thickness of foundation, since old macadam or gravel of considerably less depth may be utilized by overlaying with bituminous concrete, bituminous macadam or broken stone.

Edging for Highway Pavements

Several types of edging or curbing are adaptable to resurfacing of this character, such as cement concrete, stone, metal, plank and a bituminous concrete header or heel, which may be satisfactorily used instead of curbing. Among these, cement concrete is perhaps the most satisfactory in some respects, while bituminous concrete used in the form of a heel, possesses the advantage of positive bond with the top course and is less subject to tilting or displacement due to lateral pressure. Stone curbing is very susceptible to displacement, unless set in a bed of concrete, which makes it ordinarily cost more than concrete. Plank, preferably 3 by 12 in. oak, supported by split cedar posts, spaced about 5 ft. apart, and extending into the sub-grade 18 to 24 ins., will perhaps prove the best when a saving in the first cost dictates the least expensive type of construction. Plank edging, naturally, will not last as long as the other types indicated, and should not be used if very heavy or dense traffic is expected.

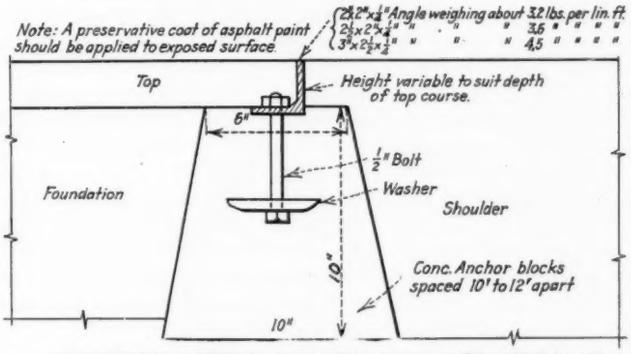
Very few metal edgings will be found satisfactory, nevertheless, it is possible to build one which should serve the purpose admirably and still not be prohibitive as to cost. As

FAILURE OF 6-IN. CEMENT CONCRETE FOUNDATION TO ARCH OVER WEAK SUBGRADE. PAVEMENT CARRIES AVERAGE TRAFFIC INCLUDING A FAIR PERCENTAGE OF TRUCKS.

shown in the accompanying sketch angle irons about ¼ in. thick, bolted to concrete anchor blocks set about 10 or 12 ft. apart should prove satisfactory, and at present prices would very probably cost less in place than concrete or stone curbing. Special forms and extreme care in securing blocks of exactly the shape indicated are not necessary; blocks deep enough and wide enough and properly spaced to securely anchor the irons is the main objective.

Practical Methods of Preparing the Old Roadbed for Use as a Foundation

The first operation in preparing the old pavement for its intended use as a foundation is the thorough cleaning of the

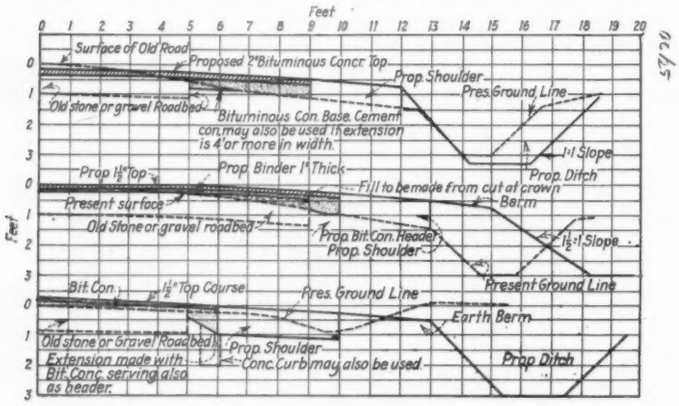

Note: A preservative coat of asphalt paint should be applied to exposed surface.
2½"x2½"x¼" Angle weighing about 3.2 lbs. per lin. ft.
2½"x2½"x⅜" " " " " 3.6 " " " "
3"x2½"x⅜" " " " " 4.5 " " " "
Top
Height variable to suit depth of top course.
6"
½" Bolt
Washer
Foundation
Shoulder
Conc. Anchor blocks spaced 10' to 12' apart
10"
10"

PROPOSED METAL EDGING FOR RETAINING BITUMINOUS WEARING COURSE ON HIGHWAY RESURFACING OVER OLD STONE AND GRAVEL ROADS.

surface. If the pavement has been oiled or carpet-coated with bituminous material, the crust thus formed must be removed. This may be done to the best advantage by spike-rolling the surface, thereby breaking through and loosening the crust so that it may be easily removed with picks and shovels. After this top layer has been removed the surface should be thoroughly swept, preferably by means of a rotary street sweeper,

or if such is not available, by means of stiff-bristled handbrooms. After sweeping there should be no loose material remaining, and the uppermost stones composing the roadbed should be partially exposed.

Old street pavements are often inclined to be flat as a result of wearing down the central portion under concentrated traffic, while the average country road is likely to have more crown than is required for the new pavement. In either case the roadbed must be either built up or cut down, or both, to conform to the required elevation. Cutting is to be avoided



CROSS SECTIONS SHOWING SUGGESTED METHODS OF INCREASING WIDTH OF OLD ROADS.

as much as possible, however, conditions may be such that some cutting will be found necessary.

Extreme care must be exercised in removing metal from the old pavement; the bond should not be disturbed below the depth of material to be removed, nor should the cutting reduce the depth to less than the allowable minimum. Scarifying may be employed providing it is carefully done. All material removed in cutting down and subsequently used for filling in low areas, should be thoroughly rolled with a three-wheeled roller weighing 12 to 15 tons.

The fact that an old road has more crown than is suitable for a permanent pavement has been used as an argument against resurfacing, whereas, such a condition is of minor consideration, if not of real advantage, since an increase in the height of the pavement above the side ditches is ordinarily desirable.

The fill required to bring the outer edges of the pavement to the proper elevation for producing the desired crown effect in the new pavement may be considered excessive; if so, it may be compensated by removing some material from the center portion and using it in the side fills.

Materials for building up the old pavements may be classified on the basis of efficiency in the order named: Mechanically mixed bituminous concrete, bituminous macadam, and broken stone; the latter being applied and thoroughly rolled without adding screenings, or regular water-bound macadam construction being used. Broken stone is advisable rather than gravel, because the aggregate having greater angularity is more securely interlocked. Selection should be based upon the condition and depth of the old pavement and the character of the traffic anticipated. All of the above have been used and have proven highly satisfactory.

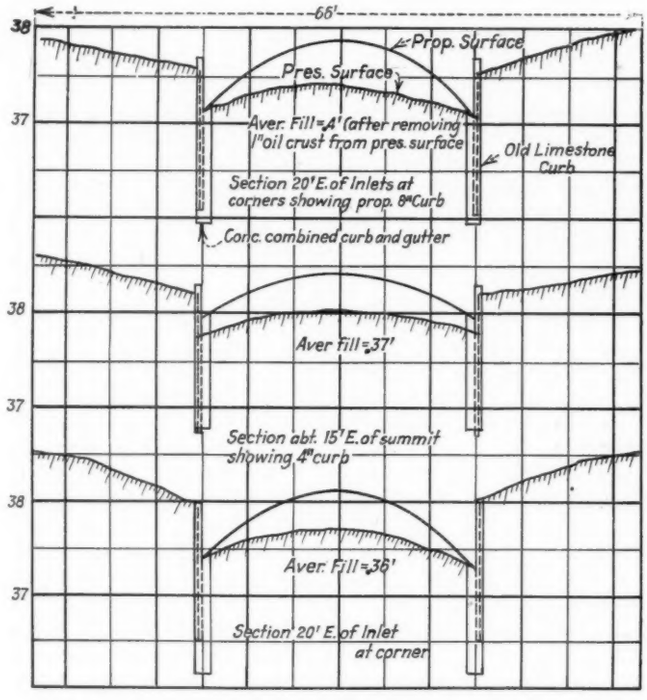
When broken stone is used, it is spread over the old pavement, after the same has been cleaned as previously described, and then raked to grade; rolled and re-rolled with a three-wheeled roller of 12 to 15 tons weight. As depressions develop during the rolling more stone is added and the rolling continued until the stone is well keyed, and a firm, even surface, true to grade and contour is produced.

If the true macadam type of surface is desired, the stone is laid and rolled dry as above described, after which screenings are added and rolled in, first dry, then adding water, and the rolling continued (low spots being "picked up" by adding more stone and screenings) until a first class macadamized surface has been produced. When this method is used, sufficient time must be allowed between finishing the foundation and laying the top course to permit the macadam to thoroughly dry out. By omitting the screenings and water, the wearing course may be laid immediately after the final rolling of the base.

Bituminous macadam should be laid according to the best construction, the binder being applied by means of a pressure distributor. If the surface of the original pavement is so irregular that the depth of the new material will vary considerably, the low spots should be filled up, rolled and poured so that the final layer will be of fairly uniform thickness. The quantity of binder applied must be in proportion to the depth of stone in order to avoid fat and lean spots. For this reason it is especially important that the base be built up in layers not to exceed, say, 3 ins. thick, when the old surface happens to be very irregular.

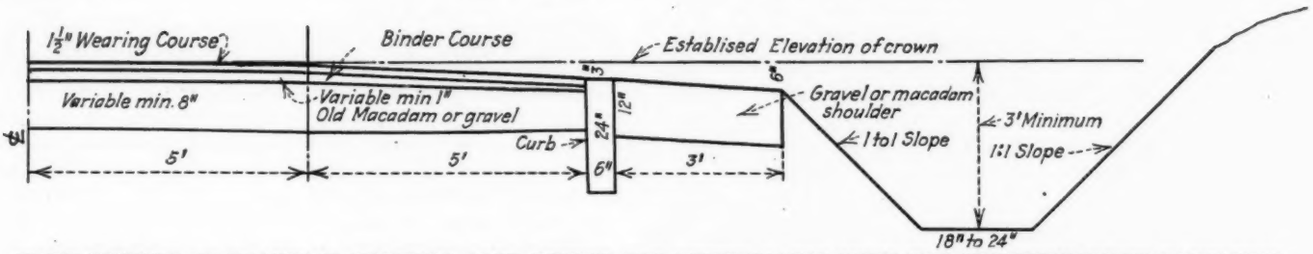
Irregularity of old surface will also dictate building up in layers, when machine mixed bituminous concrete is used. The use of either type of bituminous material as a means of building up the old pavement, will do away with the use of a binder course, providing the entire surface is covered. If only portions of the roadbed are covered, a binder course should be employed except for very light traffic which would warrant a wearing course of 2 ins. of bituminous concrete.

In determining the type of construction to be used in building up an old pavement, the uniformity of thickness of the old metal is a most important factor. For example, if the old pavement has a great many depressions of considerable depth, giving such extremes as, say, 3 ins. of old material in depres-



TYPICAL CROSS SECTIONS. PROPOSED STONE-FILLED SHEET ASPHALT RESURFACING (1½ INS.) ON ASPHALTIC CONCRETE INTERMEDIATE COURSE (AVG. 2½ INS. THICK) OVER OLD MACADAM PAVEMENT (6 TO 12 INS. THICK) BADLY WORN.

sions and 8 to 10 ins. in high spots; it would very probably be unwise to attempt to build such a surface up to grade with anything short of a high class bituminous mixture. In other words, extremes of thickness of old metal ranging from, say, 3 ins. to 9 ins., with the average at 6 ins., will not have as much inherent value as a foundation as will an old pavement



HALF SECTION OF ROADWAY SHOWING GOOD DESIGN FOR RESURFACING WITH HOT MIX BITUMINOUS PAVEMENT.

ranging in thickness from 5 to 7 ins., and averaging 6 ins.; consequently material possessing considerable stability should be used to build up an old pavement which consistently shows extremes in depth.

Protection Against Settlement of Trenches

Trenches incident to underground construction and repairs, which are excavated during the preparation of the foundation, as well as old trenches showing signs of weakness, must be carefully insured against future settlement. Old trenches and soft areas of the old roadbed which develop depressions during rolling or which may otherwise indicate lack of stability, should be excavated and refilled with broken stone, gravel, sand or some other material of equal merit. The fresh material should be tamped to excess in layers not to exceed 8 ins. in depth, and each layer should be puddled, but not flooded.

Extreme care must be taken in backfilling newly excavated trenches. If the original material is sand, or gravel, or if it contains a considerable per cent. of sand or gravel, it may be used for backfilling; but if the natural soil is clay or loam, or some other soil which naturally requires considerable time in which to reach final settlement, the trenches should be backfilled with such material as above designated for refilling old trenches. In either case tamping and puddling the layers must not be neglected.

The backfill should be carried about 2 ins. above the normal foundation elevation and then rolled and re-rolled with a heavy three-wheeled roller until the surface of the backfilled trench conforms to the proper foundation elevation.

In extreme cases, trenches may be partially filled as above described and a concrete slab, reinforced or plain, as necessity will require, may then be laid over the backfill, extending 12 ins., or so beyond the sides of the trench, and bearing upon solid earth. Concrete so placed should be suppressed and overlaid with 6 or 8 ins. of broken stone.

Thickness of Surface Mixture

Hot mixed bituminous surfaces are most readily adapted to resurfacing work. When used to resurface old roadways, as herein discussed, the usual and well known qualities and advantages of sheet pavements are increased by freedom from cracks, upheavals and other defects inherent in concrete foundations; speed of construction; and lower maintenance expense.

A binder course should be specified, providing the old surface is not entirely covered with bituminous macadam or concrete in the building up process. Although a 2 in. top of asphaltic concrete is used for very light traffic, such as will be found on strictly residence streets; a top course 1½ ins. thick laid on a 1 in. binder course is much to be preferred and should cost only 15 to 30 cts. per square yard more than the 2 in. single course construction.

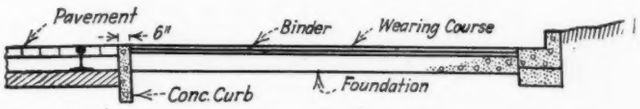
Two course pavements may be specified on the basis of traffic as follows:

Character of Traffic	Thickness Top course	Thickness Binder course
Light	1½ ins.	1 in.
Medium or moderate	1½ ins.	1½ ins.
Heavy and very dense	1½ to 2 ins.	1½ to 2½ ins.

Results of Resurfacing

It is thought that the accompanying table and charts relative to maintenance of old macadam street pavements and initial saving obtained are especially enlightening in so far as demonstrating the economical effect of resurfacing old roadways is concerned.

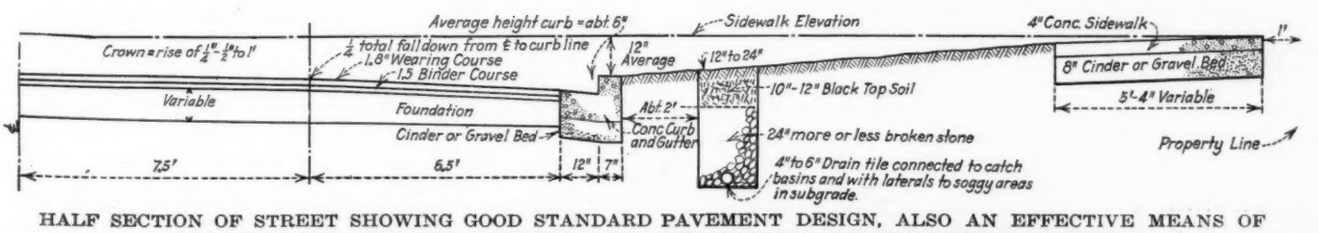
On Jan. 1, 1919, Oak Park, Ill., had 85.6 miles of pavement, including 2.45 miles of alley pavements, showing an increase of 80 per cent over the mileage in 1910. Of this



WHEN PAVEMENTS ON CAR TRACK STREETS ARE RESURFACED CONCRETE CURB SHOULD BE BUILT ALONG TRACKS AT END OF TIES.

85.6 miles, 50 per cent was sheet asphalt and asphaltic concrete, and 30 per cent. was old macadam which is treated yearly. No macadam has been laid since 1912.

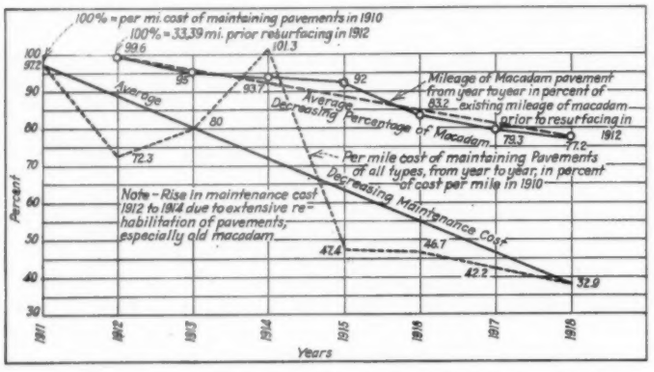
During the three years, 1916 to 1918, $32,253.95 was spent in maintaining old macadam pavements. As shown in the table the average expenditure per year was $10,751.32, or $404 per mile of macadam pavement. To bring this home, macadam maintenance cost the taxpayers at the rate of $129.67 per year per mile of street pavement within the municipality. Since maintenance expenditures come out of the general funds, every taxpayer is compelled to pay his proportionate share toward keeping up these old pavements, regardless of whether or not he may have already paid for a permanent pavement in front of his own property (under the special assessment plan) that requires a maintenance expense representing an insignificant portion of the unit rate for macadam. From this it will be seen that, unless the maintenance cost of all pavements is charged directly against the abutting property, injustice to some cannot be avoided when any considerable portion of the total pavement mileage is the source of such a large annual maintenance expense. It is significant that the average yearly maintenance cost of all other types combined amounted to only a few hundred dollars, as against the thousands spent yearly for maintaining old macadam roadways. The curves show conclusively what a remarkable effect the



HALF SECTION OF STREET SHOWING GOOD STANDARD PAVEMENT DESIGN, ALSO AN EFFECTIVE MEANS OF DRAINING SUBGRADE BY INTERCEPTING WATER FALLING OUTSIDE THE PAVEMENT.

resurfacing of these pavements had upon the maintenance costs, even in the face of rising prices of labor and material.

Notwithstanding the large amount of money spent in maintaining these old pavements, they are not to be compared with permanent pavements on the basis of smoothness of surface, pleasing appearance, cleanliness and low traction resistance. Moreover, in order to minimize the tendency of macadam pavements to become flat and develop ruts, they are



EFFECT OF RESURFACING OLD MACADAM PAVEMENTS WITH ASPHALTIC CONCRETE UPON COST OF MAINTAINING PAVEMENTS AT OAK PARK, ILL.

usually given a high crown, which renders them decidedly dangerous in wet weather after they have been oiled or carpet-coated.

The accompanying graphs showing the saving in initial cost are taken from actual costs on work laid in the vicinity of Chicago during the years indicated. An extensive yardage of work is represented in these figures, therefore the conclusions to be drawn are based upon representative facts and conditions. It is safe to say, that at present prices, the average old stone or gravel pavement may be utilized as a foundation for some permanent type of surface for approximately $1 per square yard less than the same pavement would cost if laid on a new concrete base.

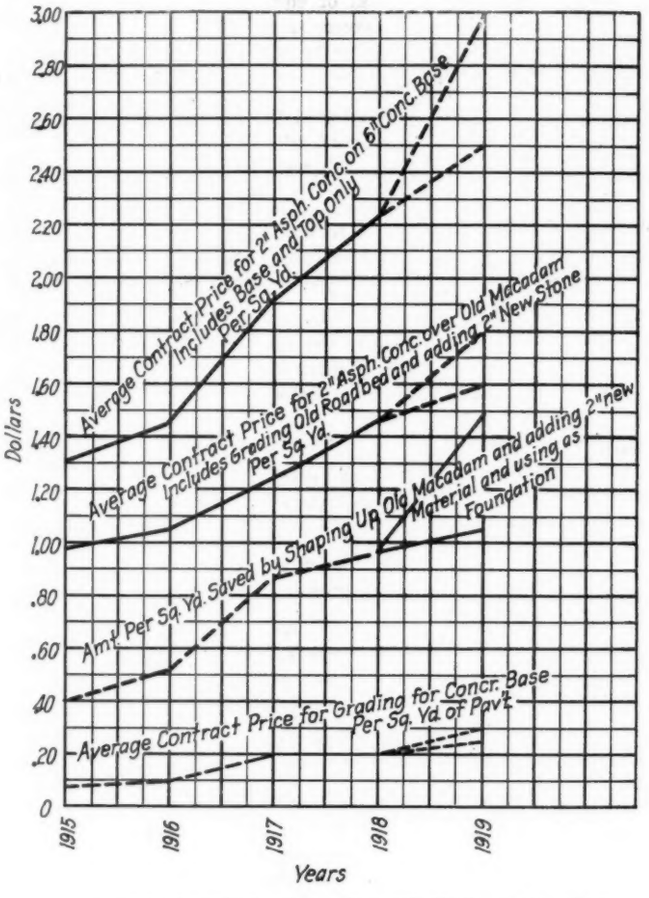
Conclusion

There are undoubtedly many miles of old roadways in every community which are either in a very bad state of repair, many of them being well nigh impassable, or, if any attempt is made to keep them even in a fair condition, are a source of continual expense. With very few exceptions these old pavements possess an intrinsic value not to be laughed at. When properly utilized, their practicability as foundations for first class pavements, has been proven beyond a shadow of doubt.

Some type of bituminous surface will ordinarily be found to be the best material for resurfacing these old roads; first, because bituminous mixtures are peculiarly adapted to this class of work; (2) they are the least expensive among the various types adapted to resurfacing work; (3) maintenance expense is very small; repairs being quickly and satisfactorily made at low cost; (4) sheet pavements are highly sanitary, of pleasing appearance, noiseless and watertight; and (5) the bituminous top may be laid immediately after preparing the base, and the roadway opened to traffic in a very few hours, thus avoiding the long period required for curing concrete.

In rigid foundations, vibration increases as the rigidity increases. Solidity rather than rigidity is the primary desideratum of foundations. The downward deflections of a concrete pavement or foundation slab under continually varying loads exerts pressure against the sub-grade. If the soil composing the sub-grade is sufficiently susceptible to compression, uniform contact between the bottom of the slab and the sub-grade is eventually destroyed. It is plain to see that when the sub-grade becomes sufficiently depressed, the slab is called upon to arch over the depressions, thus setting up high tensile and shearing stresses. Numerous practical demonstrations of the result of the inability of cement concrete to maintain uniform contact with the sub-grade are to be found.

Macadam and gravel foundations by virtue of their close contact with the sub-grade are not subject to high tensile stresses, therefore, when an old pavement, which has passed through the settling period, is used as a foundation, cracks



ACTUAL SAVING DUE TO UTILIZING OLD MACADAM PAVEMENTS AS FOUNDATIONS FOR ASPHALTIC CONCRETE.

and ruptures of pavement are much less likely to occur.

Grave danger lies in the failure of those responsible for the administration of public works and the release of public funds, to provide careful designing, wise selection of materials and intelligent supervision, and to make sure that contractors are selected who are not likely to perform their work

MAINTENANCE COST OF OLD MACADAM STREET PAVEMENTS IN OAK PARK, ILL.,—1916 TO 1918.

	Light Oil Dust Layer Treatment			Repairs, Preservation, Carpet Coating, Etc.			Total Maintenance Cost			Mileage of Street Pav. in Town	
	Miles	Cost		Sq. Yds.	Cost			Per Mi.	Per Mi.		
Year	Treated	Amt.	Per Mi.	Treated	Amt.	Per Yd.	Amt.	Macadam	Pavement (all kinds)	Macadam	All Pav.
1916	34.75	$5,744.24	$165.00	19,632	$5,207.12	$0.265	$10,951.36	$395.00	$131.00	27.78	80.46
1917	25.22	5,299.84	223.26	26,453	5,201.23	.197	10,501.07	397.00	128.00	26.48	82.37
1918	16.12	4,151.50	257.53	31,154	6,650.02	.214	10,801.25	420.00	130.00	25.79	83.15
Totals and averages	76.09	$15,195.58	$199.70	77,239	$17,058.37	$0.221	$10,751.32	$404.00	$129.67		

N. B.—Alley pavements not included.

in a haphazard and careless manner. The building of pavements is, and should be, a science. The old idea that most anybody could go out and make a road is fast vanishing—it should be dissipated wherever it still prevails. Road building is the largest item of public expenditure and it is on the increase. An investment of such magnitude must be wisely made and safeguarded. Better roads must be built, and maintenance must be systematically carried on. It is deplorable that in many localities those best equipped have the least to say of what and how the pavement should be constructed.

Some Practical Points to Observe in the Construction of Bituminous Pavements

By R. Keith Compton, C. E., Chairman and Consulting Engineer, Paving Commission, 214 E. Lexington St., Baltimore, Md.

This discussion is intended to cover bituminous pavements of both fine and coarse aggregate, to outline the main features of inspection and construction, to describe the method of carrying out the specifications and to call attention to conditions confronting us with present day bituminous construction, which must be overcome in order to secure the desired results. Expert and detailed specifications and methods may be drawn up and provided for, but unless they are properly carried out, and what may be considered minor details strictly looked after, poor construction is likely to follow.

The Bituminous Pavement

The writer knows of no better way to describe the bituminous pavement than to quote from a similar paper delivered by Mr. Francis P. Smith at the Montreal Convention in 1916, as follows:

"Bituminous pavements, especially those with fine material aggregates, are smooth, non-productive of dust, almost noiseless, waterproof, non-absorbent and easy to clean. They are capable of sustaining very heavy traffic and also last well under light traffic. They are therefore well adapted for business and residence streets, and the facility with which they may be kept clean makes them especially desirable in tenement districts. They are easy to repair and offer but slight resistance to traffic. They are somewhat softer in summer than in winter, but when properly laid never become too soft for use even in the hottest weather. When dry and clean they are not at all slippery, but their slipperyness in moist weather is largely due to the presence of a thin film of mud caused by the collection of street detritus and this can be greatly reduced by washing or keeping them clean. For this reason they are less slippery in a heavy rain than in a drizzle. Horses accustomed to granite block pavements instinctively put their hoofs down and slide them until they obtain a foothold in the crevices of the pavement. As there are no such crevices in a bituminous pavement, it takes a little time for them to become accustomed to it, but they soon learn to adapt themselves to a smooth surface."

Some Characteristics of Bituminous Pavements

Bituminous pavements will withstand and sustain a very heavy amount of traffic, preferably quick moving, light or medium loaded vehicles, such traffic, for instance, as prevails on many of our business streets. It is not claimed to be particularly adapted to dense, slow-moving, heavily loaded traffic. Some block pavements will outlast it under such conditions. It must have some traffic. If a bituminous pavement is laid on a street and traffic completely blocked off for several months, exposure to weather conditions will cause volatilization or evaporation of the lighter oils leaving the pavement hard, brittle and almost worthless. Its life requires some traffic in order to cause the kneading action necessary for it to retain these articles which are the very life and durability of the pavement itself.

Choosing Type of Pavement

Before deciding on the type of pavement to install a well informed engineer will take into consideration the extent, volume and character of traffic, the grade of the street, the width of the paved driveway between curbs, whether or not street railway tracks exist, character of the section to be served, whether business or residential, whether noise is a factor, and it generally is, and whether or not the street is in close proximity to a water front, as bituminous pavements will not withstand moisture. They must have occasion in which they can fully dry out. This will not be the case on a water front street because the moisture will come up through the concrete and deteriorate the pavement from its under side, effecting first the binder and then the top.

Grades

It is not claimed that sheet asphalt, which is a bituminous pavement of fine aggregate, is suitable for excessive grades. A grade may be excessive under certain traffic, but not under other traffic. Generally speaking, 6 per cent. is the maximum grade for sheet asphalt on a heavy traffic street. On lighter traffic streets it has been laid with great success on grades up to and including 12 per cent. When excessive grades are encountered it is well to use a bituminous type of coarse aggregate such as bitulithic or asphaltic concrete. It is a well established fact that bituminous pavements are most slippery on light grades during bad weather when the pavement is covered with a thin film of slimy mud with insufficient rain water and grade to make it self-cleansing. This same condition does not exist on grades 3 per cent. and over.

Pavement Base

The pavement is no stronger than its base, therefore, great care must be exercised in deciding upon its character and thickness, depending mostly on the character and volume of traffic, but largely on the character of the sub-grade. Various kinds of base or foundation have been used; old macadam, cobble, brick and granite block have been resurfaced, using the old pavement as a foundation. Practical experience has proven that this is not first class construction although it has been followed with success in many instances. Its success depends entirely on conditions of the old pavement when the new top is installed and extreme care must be used in all phases of this construction.

Assuming that one decides to resurface an old cobble or block pavement, he proceeds to notify all public service corporations and city departments to install their construction before paving operations are started. After they are through it frequently happens that very little is left of the original pavement. In other words, that which you had intended to use as a foundation has been practically destroyed and it cannot be replaced in its original condition. In the meantime your contract has been awarded on that basis and there is nothing for you to do but to proceed. An ever increasing volume of traffic attracted to the new pavement soon breaks through the foundation and the topping starts to disintegrate.

Assuming that the old pavement remains in its original condition, its contour will probably not conform to the contour which is desired for the new pavement and the difference has to be made up, probably a half inch in one quarter, several inches in the center and more or less on the other quarter. As there is not sufficient room for concrete, it is concluded to make it up with the binder. This means an excessive amount of binder, probably lack of compression, resulting in a wavy, poor surface which may not develop at first, but undoubtedly will later under traffic. While this practice is not condemned, it is desirable to call attention to defects which may develop unless extreme care is used not only in inspecting the old pavement, but also great care must be used in looking

after the details of construction when the new pavement is laid. When the traffic is light as on state roads where they may not be main arteries of traffic and on some residential streets, old macadam has proven to be a suitable foundation for bituminous pavements, but the same precautions must be taken as that outlined for cobble and block foundations. The most desirable foundation for a pavement is concrete from 4 to 8 ins. in thickness, depending on the factors named, generally 6 ins. and of a 1-3-6 mix. The sub-grade should be thoroughly drained and compacted before the foundation is laid.

Specifications

Specifications should be drawn without making either principal the goat, but should be broad and in detail, but not in such detail as to be burdensome and misunderstood. The specifications having been drawn, the contract duly advertised, awarded and executed, then comes up the question of construction and inspection.

Inspections

We must emphasize the importance in the construction of bituminous pavements of strict plant, laboratory and street inspection. Street inspectors should cover not only hot materials but the concrete base and all other items as well. The street inspector must see that the concrete, if mixed on the street, is of the proper proportions, that the proper size stone, character of sand, etc., is used.

Central Mixing Plants

Central mixing plants for extensive paving operations are now coming into vogue in large municipalities, thus avoiding congestion on the street in the storage of immense quantities of stone, gravel and sand, and hindrance to traffic, accidents, etc., and in case of storms or heavy rains much loss of lighter materials. The material is mixed at the central plant under the supervision of an inspector, transferred to the street in trucks and then handled very much the same way physically as the asphaltic material, but always under the supervision of an inspector on the street. Experience so far seems to indicate that this plan can be worked successfully provided the haul is not too long, say not exceeding 20 minutes. In this case sand and some loam is preferred to the absolutely clean sand because the latter is apt to cause a separation of materials in transit. This plan is at present working in a very systematic and practical way and as it is extended improvements will be made, so that in course of time streets can be improved in a congested section without so much interference, burden and inconvenience to traffic and the general public. Regarding inspection of hot material the following plan in vogue in many of the large municipalities is outlined, and it has been found to work in a most satisfactory manner.

Inspection of Hot Material

An adjunct of the municipal laboratory is established known as the asphalt division, in charge of a chief asphalt inspector with sufficient sub-inspectors to cover all asphalt plants. This division also looks after the inspection of other materials such as stone, sand and cement and finished concrete. Depending on whether the concrete is mixed at a central plant or on the street, the chief asphalt inspector visits the points of mixing and selects the sample of concrete as it comes out of the mixer. This is sent to the laboratory where under the following process the street inspector is checked up, and we can tell very closely whether or not he is following the mixture provided for in the specifications. A sample of concrete base is taken from the grade after it has been raked and tamped (about one 14-quart bucketful), but before it is set. This material is then washed and the aggregate separated by screens, the ¼ in. screen to remove the stone and the 10 mesh to remove the larger particles. The remaining sand and cement is then dried and screened over a 100 mesh sieve and what material passes the 200 mesh is, after making calculation for amount of very fine sand which passes the 200 mesh, taken as cement. It is not claimed that this process is absolutely correct, but it very closely approximates the actual proportions being used. Then again, the specifications may provide for a compressive strength test on a cube of finished concrete where cement concrete is used as a wearing surface. This is also handled by the chief inspector, who selects the sample, cures the concrete under field conditions, makes the test in accordance with standard practice and reports results to main office.

At each asphalt plant is stationed an inspector, who is equipped with screens, balances, a penetration machine and thermometer to be used in testing the stone, sand, asphalt cements and temperatures of the finished mixtures. All incoming raw materials are tested by the inspector at the plant, as received, except the asphalt and residiums, which are sampled and sent to the laboratory for analysis before they are used. Samples of the stone, sand and dust are also taken to the laboratory and tested. The inspector is given a mixture showing the percentage of stone, sand and asphaltic cement by which to turn out the binder mixture, also the penetration at which the binder cement is to be maintained, each kettle being tested before it is used.

The procedure for topping mixtures is as follows:

After the sand has been tested the inspector is given a formula, telling the mesh composition of the sand, the amount of sand, limestone dust and asphalt cement to be used, also the penetration of the asphalt cement. These instructions are received from the chief asphalt inspector. Each plant is visited at least once a day by the chief asphalt inspector, who makes an inspection of the plant and materials being used and collects samples of the asphalt cements, finished mixtures and the inspector's reports. These samples are taken to the laboratory, the asphalt cements being checked and the mixtures analyzed and any irregularities noted and the plant inspector immediately notified of same. The chief asphalt inspector during the day visits each street on which any material is being laid and takes samples, which are tested, and if found deviating from the mixture set, the inspector is at once notified of it and the trouble remedied.

When the mixtures arrive on the work they are tested for temperature by the street inspector, who oversees the laying of the binder and surface mixtures, seeing that the surface gets the proper amount of rolling and that the binder and wearing course are of the required thickness. The street inspector at the finish of each day's work sends a post-card to the laboratory showing the number of loads and batches of material received on the work, and also the yardage of material laid. These figures are checked against the reports of the plant inspector, the yardage per batch obtained and a report of same made to the principal assistant engineer and any irregularities noted and corrected. A record is on file at the main office and at the laboratory, of the cubical contents of the mixing box at each plant. A standard is set of how many square yards of a known thickness each batch should lay, after compression. In this manner we can tell whether or not the binder and topping laid on the previous day are of the required thickness as a check on the street inspector.

Brick Gutters

As a general rule brick gutters from 12 to 18 ins. in width should be used on bituminous streets. They are absolutely necessary where there is any amount of surface drainage. Where all surface drainage has been eliminated they are still necessary on grades up to 2 per cent., but they are desirable on all bituminous streets, for two reasons. Gutters are for the purpose of collecting the water, and consequently the space next to the curb is nearly always damp, owing to collection of drainage, debris, etc. Furthermore, it is not always feasible to roll bituminous material in close proximity to the

curb and the very existence of the gutters permits a more accurate cross section and contour and also permits the accomplishment of better compression and more expert handling of the roller.

Handling on the Street

Even though the hot material has been handled with expert care at the plant and transported to the street, great quantities of such material have given poor results, owing to defective handling on the street, such as poor raking and poor rolling. Too much care cannot be exercised in expert raking and rolling. Each load should be spread in a space separate and distinct from where it is dumped. One great difficulty in handling this material on the street is the practice of the spreaders or rakers standing in the material. This can be avoided by shoveling channels, commonly known by the men as "alleys" through the material for workmen to stand in; spreading the material in a space separate and distinct from that where it was deposited eliminates danger to a very great extent of any foreign matter such as blocks of wood and tin sometimes used by the careless drivers in order to close up crevices in the body of the hauling vehicle. Rolling material when it is too hot causes it to buckle and overlap. The use of too much water when rolling, which is very prevalent and a great temptation, causes blisters. Both of these practices should be avoided. It is very difficult to obtain full compression in close proximity to hard surfaces whether by tamping or by rolling, so that it is desirable to keep the finish about ¼ in. high along gutters, liners, castings, etc., otherwise full compression, which is eventually obtained under traffic, will soon cause depressions.

Rate of Rolling

With further reference to the matter of rolling, so many yards should be allowed per hour, per roller, approximately 250 for binder and 150 for wearing surface. With expert roller men this can be slightly exceeded, but it is important to keep the rollers continuously in operation as far as possible. It is preferable to start rolling with the lighter roller, then after the material has somewhat cooled off, follow with the heavy roller, using as the occasion may require, both rollers for the final finish. Hot smoothing irons may be a necessary evil, but should be avoided as far as possible, as they are exceedingly dangerous and attractive weapons in the hands of men who may carelessly and unnecessarily use them. It is necessary to use for a final covering a material to close up the pores, usually Portland cement. It should be spread and swept almost clean by skilled labor. It is poor practice and very wasteful to use too much of this material. One such man will save enough cement in an eight hour day to more than pay his wages. Too freely used it causes an unsightly finish.

Sheet Asphalt Construction

Practically the same details of inspection enter into all classes of bituminous construction, although the construction of the bituminous portion of the pavement is not the same for all types. The standard sheet asphalt construction at the present time consists of 1½ in. binder and 1¼ in. top, laid on the foundation, while the standard bituminous pavement of coarse aggregate usually consists of 2 ins. of bituminous material of the same mixture throughout laid directly on the concrete. All dimensions given are those obtained after full compression. The coarse aggregate type, being an open mixture, it is covered with what is known as a squeegee coat of bituminous cement, after which stone chips are applied. Moderately close binder is recommended for all pavements of the sheet asphalt type. The binder should contain a sufficient amount of asphaltic cement and fine material otherwise it will break up under the vehicles transporting the top to its position on the street. Not more than one day's run of binder should be allowed and this should be swept clean before the topping is installed so as to secure a bond.

Coarse Mixtures

The asphaltic content of coarse mixtures should be given more attention and kept within closer limits than will be necessary with sheet asphalt mixtures. This is because there is a closer relationship between the mineral aggregate and asphaltic cement in the coarse pavements than in the finer ones, and no great variation one way or the other in the amount of bitumen used is likely to cause trouble. Too much bitumen will cause the pavement to become soft, which means that it will be wavy and it will cause it to roll. Not sufficient bitumen will cause the pavement to be open, dry and to disintegrate.

When a bitumen pavement joins a block pavement whether of brick or stone, a header must be used so as to keep both pavements in position, neither one being rigid in itself. The most common header used is of stone such as old curbing, fairly well dressed with its surface showing between the two pavements. This, however, is unsightly and in time a hindrance to traffic. A desirable header is one of some hard substantial material such as stone or concrete, but countersunk, say, 2 ins. below finished grade. This will hold the block pavement in position and at the same time allow the bituminous topping to be carried over flush with the surface of the block pavement, causing both pavements to maintain an even, smooth surface.

It is these points which, if closely followed by engineers and inspectors, will give a good workmanlike, satisfactory, bituminous job. If not followed, one may expect trouble in many of the several items covered.

Acknowledgment

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The Trend in Municipal Refuse Collection and Disposal—Estimating Costs

By Rudolph Hering, D. Sc., Consulting Engineer, 170 Broadway, New York

In complying with the editor's request for a short article on the subject of Municipal Refuse Collection and Disposal, I can do no better, I believe, than endeavor simply to point out the directions in which this branch of municipal work is progressing, and thereby assisting those in charge, when they are studying ways and means of improving their local plant, to approach the most promising solution of their problem.

The community refuse, which in this small space is worth while considering, consists of garbage, or chiefly kitchen refuse, and of ashes, or chiefly the remains of coal fires, and of rubbish, or the miscellaneous trash or solid waste accumulating in or about buildings used as domiciles, stores or factories. Nothing will here be said about street sweepings or manure, not only because the latter is continually decreasing in quantity, but because they can both be either treated as rubbish, and sometimes as fertilizer, if justified by the analysis and the distance of haul through the suburbs; or, under certain precautions, they may both be dumped to make land. Nor will anything be said of the collection and disposal of night soil and dead animals, as the quantities are small and the treatment is comparatively simple.

Development of the Art

Garbage, ashes and rubbish form the materials which give the authorities the most trouble; and this trouble increases as the community grows larger. More than a century ago the practice was common to feed animals with garbage and to dump its surplus and the rest of the municipal refuse at any convenient places. In many old cities the ashes, then mostly

wood ashes, and the rubbish were dumped and leveled on the roads used for travel, which raised them, gave them a harder surface, and improved their drainage. Roads built up in this fashion have been found in old cities both south and north of the Alps.

As cities grew and their inhabitants became more particular in their demands upon the local government, the promiscuous dumping in town was often considered objectionable, thereby necessitating the distance of haul to be increased. Where the expense of hauling grew large, and as most of the refuse is combustible, it was suggested to destroy it on open lots by burning, in order to remove the objectionable qualities and leave only ashes.

Nearly a hundred years ago, in England, where the cities were beginning to grow rapidly, it was first suggested to burn the refuse in specially built furnaces. Meantime the use of coal had become common and coal ashes were produced. The rainy climate turned some of them rather black, which indicated the presence of a large amount of unburnt coal and cinders (together 25 per cent.) in the ashes from the domestic fireplaces. At the same time there was more kitchen garbage produced than desired for feeding animals in and near the town, and the surplus was and had to be thrown upon the midden, which was the dung, rubbish and ash heap. This mixture of refuse, in the English midden, particularly as it contained a large proportion of unburnt coal, was found capable of being incinerated in furnaces. The first one for this purpose was constructed by Fryer of Nottingham. The refuse was burned so completely and satisfactorily that only ashes were left, but no organic matter.

Incineration

The result was that the incineration of refuse was adopted in other cities and became quite general in England and later also in many cities of the European continent.

The furnaces were gradually improved and became more efficient and more economical. In nearly all cases the resulting clinker was used for roadmaking and other purposes, and the resulting heat of combustion was utilized for the production of steam, which has been used in several ways, lately mostly to generate electricity.

The solution of the problem of refuse incineration therefore rested on finding a satisfactory furnace for destruction and getting the greatest money return from the clinker and heat.

American Practice

In American cities the development took a slightly different turn. Some of our garbage has always been fed to animals. Generally farmers collected it and took it to their farms. In the large cities hotels and restaurants, where the amount of garbage was large, soon supplied all the food which the neighboring farms required. To collect it also from private residences, as each one supplied but a small amount, proved more expensive than the profit justified. Such collection for feeding, therefore, not being financially attractive in large cities, was abandoned, and the garbage, ashes and rubbish were thrown upon a midden heap or into cans. This mixed refuse was then either removed by the parties creating it, or it awaited collection by the town, either through a contractor or by its own employes.

Garbage Reduction

A new aspect of the problem then appeared. Examination had shown that the American garbage contained an amount of grease greatly in excess of that of the European garbage. Analytically it was found to be so great that when recovered by known processes it would yield a revenue, which, according to the promoters, would not only yield a good profit, but in favorable cases even pay partly for the garbage collection. This method of reduction required that garbage be kept in a separate can at every house and not mixed with ashes or rubbish. It also required that the amount collected in a town be large enough to pay for the installation of a reduction plant which was costly, and could be made remunerative only if the bulk of the products was sufficiently great. The first city which introduced the reduction system of garbage was Buffalo, N. Y., in 1886. A company obtained a contract to manufacture grease and fertilizer from the city's garbage, after it was delivered to the works by the city. After a year's operation the company lost money, but continued the work profitably when the city paid $20,000 a year.

Since then many garbage reduction works have been built in our country, mostly by private companies. Many of them have failed in fulfilling their contracts, partly because the process was more expensive than originally supposed and partly because insufficient money was spent by the companies to prevent a nuisance and an objectionable condition of the works.

The Cobwell System

In three cities, Cleveland, Columbus and Chicago, reduction works were built and operated by the municipalities, with fairly satisfactory results. The most promising method of reduction seems to be the Cobwell System, as first installed and operated at Los Angeles, where grease and the remaining tankage are produced without a nuisance. So long as American garbage contains a sufficient amount of grease to pay for its extraction without producing also a nuisance, reduction works will no doubt be continued in use at least in the larger cities.

Another different aspect of the problem appears in America, where the amount of garbage per capita is much greater than in Europe. Our life conditions have permitted us to be more wasteful and we discard into the garbage pail much food matter from the kitchen which in Europe would not leave it. When in Italy, I once inquired what their people did with the garbage or wasted food, and the answer was that they had none beyond what was eaten up by goats and a few pigs in the town. When examining a garbage pail I was surprised to find that even goats would find enough on which to subsist.

Garbage Disposal by Feeding

American garbage when fresh is an excellent food for pigs. If it can be obtained at no cost and we pay merely for the collection and delivery to hog farms, we have in our country an excellent means of garbage disposal, limited only by two conditions: First, the collection must be frequent enough to be able to obtain the garbage in a fresh condition, and, secondly, the distance to the feeding grounds must be short enough to prevent the delivered garbage from becoming foul.

In many instances a daily collection is feasible during the hottest weather. In winter two or three times a week will answer.

Our own food is delivered to us thus frequently, and animals, eating only one or two days later what we have left, are thereby treated sufficiently well, so that they can eventually form a part of our own food, which we desire to be good and healthful.

We can shorten the distance and time required to remove garbage in two ways. We can establish a transfer station within a city where the garbage is dumped from carts into cars, protected from sun heat and delivered quickly to the hog farm. We can also, in my opinion, establish a number of feeding places within a city and thus obtain the required quick delivery. There is no reason why such places should be offensive. Hog pens can be kept as clean as stalls for horses and cows. The pens should be built of concrete, of material not absorbing water nor having a rough surface, and should be well drained. They should be cleaned and washed at least once a day and every practical provision should be made to keep the hogs clean and healthy. Such an estab-

lishment to which the garbage is delivered while fresh could readily be made even less offensive than many of our stables are, and certainly less offensive than many of our industrial works in our cities. The only necessary conditions to get these results are frequent and quick deliveries to a plant of proper design and arrangements for feeding, and all other provisions to maintain a healthy crop of hogs.

When the fundamental conditions have justified it in our country, we have developed a number of works that have never before existed on the same scale. Why should we not solve the important municipal problem of an inoffensive garbage disposal also in the direction of providing a good food when the financial conditions favor it? So long as American garbage contains so large a quantity of healthful food material, its disposal by hog feeding will continue.

We have, therefore, in our country, under the new conditions here existing, a somewhat more complex problem to solve than has been necessary in the older countries. Because our garbage has a more inherent financial value than theirs, we are able to add to the older methods of disposal, a reduction of garbage to grease and tankage-fertilizer, and a more extensive application for feeding. We have had sufficient experience to know that all of the methods mentioned above can be made satisfactory if the works are properly arranged, well designed, and built and are intelligently operated. The only question for us yet to decide is the expense required to erect and operate a plant, because the least expensive one, among the possible plants would be satisfactory, is the one that a city should adopt.

Estimating Cost of Projects

It is important then to know the cost of the projects. Formerly, bids were sought for a furnace and its construction, or for the construction and operation of a reduction plant, and the contract was given to the lowest bidder. Later, it was found that the cost of operating an incinerator, or of inoffensively operating a reduction plant were very prominent factors and that the cheapest incineration or reduction plant often costs much more to operate satisfactorily than a more expensive plant. Thereupon, bids were requested for works, including the operating expenses on a basis of total annual cost. This proved to be a much better method.

When we have to decide the relative economy of disposal plants involving different systems, different distances for collection and different ways of final disposal, the financial comparison must begin at the origin, namely at the house. A shorter distance for collection, or a less frequent collection, will balance a greater cost for the disposal method, and vice versa. If the disposal plant can be located so that the collection distances are short, we are justified in spending more money to make it thoroughly proof against bad odors and otherwise attractive, than if the collection distances are long. We have such cases in Europe. If we must have more frequent collections for the selected disposal system, then we must either have proportionately less expensive plants, or they must yield a corresponding profit which pays for the greater cost of collection.

If the conditions of the city appear to be available for nearby hog feeding with fresh garbage, and the analysis of the garbage also justifies an inquiry into the economy of a reduction plant, the garbage must in both cases be collected separately from the ashes and the rubbish. We must then assume that the local conditions are favorable for ash dumping, and that the disposal of the rubbish will probably require incineration.

To get the lowest cost, we must first designate the best locations or points for the final disposal of the garbage, of the ashes, and of the rubbish, estimate the average distances for collection separately for each part of the total refuse, and determine the frequency of the collections. We are then able to estimate the annual cost of collecting the entire refuse at the origin and delivering it at the point of disposal, not forgetting to add the annual interest on the investment for the entire collecting outfit, stock and its housing, the depreciation, etc.

We must then, secondly, determine the cost of land, of designing and building the disposal works that may be applicable to the case, namely, feeding and reducing garbage, dumping ashes and incinerating rubbish. In each case, sufficient allowances should be made for contingencies, particularly in the line of providing all necessary means to prevent any nuisances. These estimates of the cost of construction should be reduced to the annual cost, and embody interest on the entire investment, taxes and the yearly depreciation of the works.

Thirdly, we must determine the annual operating costs of the various disposal works, as the cost of running a hog farm, of extracting grease and preparing tankage for fertilizer, of incinerating rubbish and disposing of ashes. This estimate should also include an allowance for contingencies depending on the variable cost of labor and materials.

Fourthly, we should estimate the income resulting from a sale of the products. There is an income from the sale of hogs, grease, tankage, heat from a rubbish incinerator, and there may be an income from made land.

From these four determinations, it is practicable to estimate the annual cost of the collection and disposal of the entire refuse according to whether a reduction or a hog feeding plant is used for the garbage disposal, ashes being dumped and rubbish incinerated in both cases.

Mixed Collection and Disposal by Incineration

The preliminary work, however, is not complete unless also another estimate is made, namely, one for the European method of a mixed collection and a disposal by incineration. In this case after selecting one or more suitable locations for one or more incinerators in the inhabited area, as in London, we must determine, first the cost of collecting the mixed refuse at the house, as frequently as has been decided, and delivering it to the nearest incinerator. We must also add the interest on the entire collecting outfit and the depreciation, but in this case the outfit must be for a combined collection.

Secondly, the cost of land and of the incinerator must be determined, including all facilities for producing the maximum amount of heat and of its conversion into steam power and electricity with all the necessary appliances for their respective utilization. As before, these estimates must be reduced to the annual cost, including interest, taxes and depreciation.

Thirdly, the annual cost of operating the incinerator must be estimated, including a fair sum for contingencies; and fourthly, we must estimate the annual return or income from the sale of the clinker and the return from the steam which can be profitably produced by the heat generated in the furnace. In many cities the heat has been converted into electricity, which was used for lighting and in a few cases also for loading storage batteries which supplied the power for the motor trucks collecting the refuse.

This annual cost and revenue estimate for producing heat and clinker from the refuse of a combined collection should be compared with the annual cost and revenue estimate for feeding, and for reducing the garbage, not forgetting to add to the latter two methods also the annual cost for disposing of the ashes and rubbish.

A study from such comparative cost estimates, if made on an equitable basis, should disclose the least expensive method by which a city could solve its refuse problem. If the estimates of cost include sufficient contingencies for preventing odor, first, by sufficient and frequent collection in clean wagons, and secondly, by the prevention of the generation and escape of offensive air at any part of the disposal works, the resulting least expensive project should give the desired satisfactory solution for the town.

The American Association of Engineers—Co-operation

By George C. Warren, President Warren Brothers Company, 142 Berkeley St., Boston, Mass.

Being much interested in recent articles to which Municipal and County Engineering has devoted much space, perhaps a contribution from the writer may be of use.

Beginning at the bottom as a lad, 35 years ago, continuously active during that period, closely associated with pavement and road construction work, and naturally co-operating with municipal engineers, it is my pleasure to state at the outset that, as a rule of my observation, engineers are faithful, conscientious and painstaking in the discharge of their duties. Of course, there are and always will be exceptions in this, as in every other, class of men. It will probably not be questioned that the three most glaring causes of the "exceptions," in the order of their pre-eminence, are the following:

1. Insufficiency of remuneration.
2. Uncertainty of reasonable tenure of office.
3. Requirement either by law or political custom that the engineer must be a voting resident of the municipality he serves, which brings appointment to a degree of political patronage.

These "causes" will be briefly discussed.

Remuneration

Every municipal official, as well as men in important commercial positions, should, to a reasonable degree, be care-free in the matter of support of himself and family. Too frequently in the past this rule has not applied to municipal officials in general, and engineers in particular, a condition which has more or less contributed to and reflected in:

(a) Inefficiency and inexperience;
(b) Lack of industry;
(c) Dishonesty.

To get the best from any man he must have an incentive, and one of the greatest incentives is appreciation, of which financial remuneration is a leading factor. Fortunately during recent years public opinion has rapidly improved in this respect, but much is yet to be accomplished.

Tenure of Office

Nothing could contribute more towards:

(a) Inefficiency of personnel;
(b) Falling into political patronage;
(c) Spending more time in trying to "hold his job" than in efficiency of service;
(d) Tendency toward dishonesty;
(e) Consequent inefficiency and lack of economy,

than for the incumbent to feel that his position is not likely to be held as long as he desires and shows competent, efficient, economical administration. This difficulty also seems to be on the wane, but much more can be accomplished. How much more efficient is an engineer if he is free from fear of political removal so long as he fills his office to the best of his professional ability and gives high degree of service, than if he is obliged daily to "trim his sails" to meet political requirements and approval.

Limitations of Civil Service

The writer is not one who believes that application of "civil service rules" and examination is by any means a "cure-all" for this evil. In fact he is strongly inclined to the belief that such "rule" tends toward:

(a) Selection of men of technical training rather than hard practical experience and "common sense" which is really the more important of the two considerations.

(b) Retention in important office of men who stand high in "book learning," but who really are inefficient, against whom no "charges can be preferred" or sustained.

Appointment and retention in office should be based on sound judgment rather than technical "civil service" examination. Given a man in the office of municipal engineer who attends to the business of his office and has competently for many years held office through serial administrations of varying political parties and we generally find a well organized efficient department with a man at its head who is acquainted with local engineering situations and problems such as is impossible for a new incumbent of otherwise equal ability.

In Canada, quite generally, and in European countries, more universally, competent engineers know to a reasonable certainty that their tenure of office is as long as they show efficiency and desire to retain the office, with the result that almost their sole thought is efficiency.

In Birmingham, England, for instance, the city engineer has held office to the writer's knowledge for a quarter century or more and the result is he "knows every stick and stone," as well as most of the people, in the city, and has one of the most highly efficient engineering departments in the world, and any political party which attempted to oust the incumbent, so long as that condition prevails, would be doomed to political disappointment. What an advantage for efficiency such an incumbent has!

Local Residence

In some places, largely as a result of the old "County Surveyor" principle, the laws of some cities still require that the engineer "shall be a voting citizen" of the municipality. More frequently political custom so requires. It is manifest that the result is a small list of personnel from which to make a selection, which naturally cripples efficiency.

In the year 1911 the writer had occasion in discussion of the subject, "Competition in Public Contracts" in the "American Society of Engineer Contractors" to discuss some of these matters in opposition to statements of one of its engineer members. The following extract from remarks then may be of value at this time:

> Is not the whole system of competitive bidding and award of contracts to the lowest bidder (regardless of responsibility, including previous experience in the line of work undertaken, evidence of honesty of purpose or otherwise and of the profit or loss on the work) based on the wrong principle of grinding the contractor down to a basis on which he cannot live and carry out his contract honestly; ruinously excessive competition in other words?
>
> Do not such conditions as to both officials and contractors breed and encourage, if not almost force dishonesty on the part of both?
>
> In any reform we undertake let us assume that officials (engineers or otherwise) as well as contractors are honest and place in the officials the responsibility and the confidence which that assumption would carry with it. Then pay the officials fair salaries and you will generally get good service, although at times in public as well as private life there will be an occasional wrong-doer.
>
> Let the contractors understand that their bids will be as readily rejected if too low as if too high and that experience, responsibility and general reliability in the past will weigh as heavily in determining the award as the amount of the bid in dollars and cents. Would any of us if we were to build an expensive house hire an architect who would work at the cheapest rate and then advertise for bids and say to the contractors—"The man who offers to do the work for the least money and gives a surety company bond will get the work?" What kind of house would we get on that plan? In such cases do we not consider price as only one of the many important factors for consideration in awarding the contract? Who has ever heard of satisfactory results through surety bond after the contractor has failed because the contract price is too low?

The specifications should be clear and distinct and as brief as practicable. They should avoid all trick clauses and at the end of every paragraph should state under what item of the contract and bid the work embraced in that paragraph is to be paid for. "Discretion of the engineer" should be eliminated and yet some things must be left to the "best judgment," which is another way of stating "discretion" of the engineer, but its exercise should always be fair. Too often the engineer considers his duty is to get all he can for his employer, however unfair to the contractor. In such cases it is only to be expected that the contractor will do his best to "recoup" and if the engineer is so narrow as to take unfair advantage of the contractor he is generally sufficiently dense so that the contractor can find a way to "put one over" on him. * * * *

Let contracts provide that if any item of a contract exceeds 20 per cent. of the estimated quantity the excess shall be done at cost of labor and materials plus 15 per cent., regardless of the contract price for such item, and let the engineer understand that when any item exceeds the estimated quantity by more than 20 per cent., the fact will be regarded as prima facie evidence of incompetence and be followed by rigid investigation and probable discharge, if the investigation proves the error to be due to either incompetence or dishonesty. Then, at least intentional unbalancing of bids and estimates will be promptly stopped and engineers will exercise more care than they often do at present.

In some cases the quantities cannot be accurately estimated in advance and in such cases the "cost plus 15 per cent." basis of payment for the excess will check dishonesty. Never put in a contract a clause that if certain unanticipated contingencies arise the work "will be done by the contractor without extra allowance." Nothing could be more unfair, for instance, than a clause in specifications for a pavement that if "soft or spongy places develop in the sub-grade they shall be dug out by the contractor and refilled with sound material (earth, stone, cinders or concrete *as the engineer may direct without extra charge.*" Yet this is a common clause in pavement specifications, and equally unreasonable and similar clauses are found in specifications for other classes of work.

If the contractor, in the construction, is faced with such a condition, he is sure to know he has been "robbed," and if he doesn't retaliate by "stealing" some cement out of the concrete or otherwise it will be because he doesn't know how—not because he is dishonest, for he will be pretty certain to figure out in his own mind, that, under the circumstances, such retaliation is honest. In every construction unforeseen contingencies are liable to occur. It is absolutely dishonest to throw the extra expense on the contractor and specifications should always provide for such cases, that such unanticipated or unforeseen work shall be paid for at "cost of labor and material plus 15 per cent.," or, as is the custom of the city of Toronto and some other cities, include in the specifications and ocntracts a long list of unit prices generally accepted as fair and reasonable which will be the measure of pay in case such unanticipated work is required. The cost and percentage basis is the more fair for both parties because a schedule of unit prices cannot be made which will be fair to all cases regardless of quantity or other conditions of the unforeseen work. * * *

I have known cases where such a system was in vogue and on which, from my knowledge of costs, I believe the engineers systematically estimated about 5 per cent. below actual cost in order to entice the unwary contractor and get low bids. In such cases you may be sure the contractor will "work his wits" to get even, and I believe, generally speaking, will succeed in accomplishing the end at the expense of more or less poor work, and still consider himself honest. So long as contracts are based on such lack of confidence and fairness between the contractor and engineer, so long will there be dishonesty in carrying out of contracts. Employ only competent engineers; pay them fair salaries; treat the contractors fairly, yea, honestly, and I believe 90 per cent. of the rascality in public work will be removed.

It is often the practice to estimate a nominal quantity and receive unit prices for classes of work of which some may be required but the engineer cannot tell where, or definitely, if any nor how much will be required. For instance, the estimate may have an item, "10 cu. yds. concrete" and the bids for that item are sure to be high. Is it not far better to state that if any concrete is required it will be paid for at "the actual cost of labor and materials plus 15 per cent?" * * *

I believe that if our laws were such as to give officials the same sort of freedom and exercise of judgment as is generally given to officials of business enterprises we would find more high class business men willing and glad to accept "public office as a public trust."

In conclusion, I believe the province of this association ("Engineer-Contractors") is in an effort to mold popular opinion and official action rather than in enlisting in the passage of more or less complicated laws which should be a matter of local consideration and responsibility of local officials and taxpayers, and finally to treat the matter from the point of view that both contractors and officials are to be trusted and considered honest but watched, publicly exposed and promptly discharged or prosecuted if found "wanting" in the proper exercise of the trust committed to their keeping.

The Engineer in Municipal Contracts

Perhaps a brief discussion of the attitude of some engineers toward contractors may be of use. I refer to the facts:

(a) That some if not many engineers, as evidenced by their practical actions, take the view that the engineer's position is to get the *most possible* for the municipality and not, as many contracts state and as should always be the position of fair "arbiter between the parties," which position of arbiter would in the broadest sense give the "most to the municipality" in the line of both efficiency and economy. Let a contractor realize that he is being "mulcted" and under the laws of self-preservation he is pretty sure not only to try to retaliate, but to succeed in doing so even "by ways that are dark and tricks that are vain." Such maneuvers on the part of an engineer, are, in the writer's judgment, a prime cause of such inefficient results as follow in many cases.

(b) Whether by inefficiency or "smartness" on the part of the engineer in fixing standard of prices through cost estimates (which cannot be exceeded in bidding price) so low that the contractor "must steal what he makes," how frequently the engineer and the public glory in the letting of a contract at prices at which it is doubtful if the "contractor can come out whole," to say nothing of making the reasonable profit, which it is to the interest of all concerned that he should make?

Unfortunately many contractors in bidding rely largely on the judgment of the engineer or the prices of contractors on other similar work rather than on a careful, intelligent study of the project and plans and specifications. When the engineer's estimate, which cannot be exceeded, is too low, the tendency, if not sure condition is that competition will be limited to that class of contractors who take the "gambler's chance" even if they do not deliberately hope to make a profit by "taking it out of the work" and contractors of the most responsible, conservative and desirable class will not enter into the competition. Some engineers feel they have made a mistake and sometimes are criticised by their superiors and the public when bids are much below the "engineer's estimate."

It far too frequently happens that canvass of bids is considered in comparison with the engineer's estimate rather than on careful intelligent consideration of fair return for the work contracted for. It is submitted that with a liberal "engineer's estimate," broader competition, more intelligent bidding and a better class of contractors and results are obtained than if the engineer's estimate is too low to attract the best class of contractors.

The writer has in mind a situation, quite generally in vogue for 15 years by succeeding administrations aggregating expenditure of many millions of dollars, where it has been the general custom for the engineer to estimate so low that reasonable profit for high class work is impossible, and the inevitable result has been lack of competition by the highest type of contractors and a series of broken contractors, litigation with sureties and finally browen down roads, all due to, what is most important of all, lack of proper service to the public and an unnecessary waste of funds.

Given an engineer's estimate (this is not a moot case) of "Grubbing and Clearing, lump sum One Dollar" with nothing on the plans and specifications to indicate any "grubbing and clearing" to be done, and a rule in awarding contracts that any bid will be rejected as informal if any item exceeds ten (10) per cent. of the "engineer's estimate," bidders have a right to anticipate that there will be no "grubbing and clearing," and that that is the judgment of the engineer who is supposed to have more carefully surveyed and considered the work than is possible for the contractor in the, at best, few days between his noticing the advertisement for bids and the letting of the contract. The contractor naturally passes over that item as of no consequence and makes his bid formal by bidding the item one dollar or possibly one dollar and ten cents lump sum on two miles of work. When in prosecution of the work and the setting of grade and line stakes by the engineer it develops that rows of trees and large amounts of shrubbery must be removed at a cost of about $2,000, is it or is it not more than 'human nature" for the contractor to *know* that the other party to the contract has "stolen" $2,000 of his money and to "sit awake nights" to devise means to "steal" it back and will he not generally in some way "take it out of the work" to the ultimate public detriment?

When a road contract is let, the plan of which carefully locates an available stone quarry (this is another actual case) at a certain point, the *contractor has a right* to assume that the engineer has examined the stone and found it to be acceptable and when after the award and signing of the contract the engineer rejects the product of that quarry and he is sent a hundred miles away to get "suitable" stone, the contractor has a right to know he has been "robbed" and when the other party to the contract (the "sole arbiter" or engineer) gives him no redress he is pretty apt to try his best to "recover" in the best way known to him.

Some people in every walk of life are inherently dishonest, but the writer has enough confidence in the public to believe that most men, contractors included, prefer to be honest and will give fair value if they are getting fair return. He believes that any general dishonesty among contractors is due more than any other cause to their being led into unprofitable contracts and a consequent training of their minds into a line of thought for means of "recovery.' All of this will be most easily overcome by a system of fair pay for fair return, and the certain rejection of bids which are felt to be too low to yield both a fair profit and high class workmanship.

Now to the "American Association of Engineers": It is easy to conceive that a well and properly organized, active association can correct all of these and many other things which are against the best interests of the public.

Even if the association accomplished nothing more than a clearing house where the names and experience of engineers desiring engagement can be secured by organizations looking for high-class engineer service, the existence of the association would be justified.

Experience with Granite Block Pavements in New Orleans, La.

By John C. Bartley, Sewer and Water Board Building, New Orleans, La.

Intimately associated with the early development of the city of New Orleans has been the use of granite for street paving purposes, and under the unusual difficult conditions that surrounded New Orleans, it was the only material that successfully answered the demands of traffic, and at the same time withstood the vicissitudes of this semi-tropical locality.

Historical

The city when founded, in 1718, was located on the east bank of the Mississippi, about 100 miles up the river from the Gulf of Mexico, and as laid out on this higher ground was surrounded by large open canals that emptied into swamps and bayous, i. e., small outlets to the tidal waters of Lake Pontchartrain in the rear and to Lake Borgne, some distance below the city.

Street improvements followed European practice, first with cobble stones brought over from Europe as ballast, and then the use of the old square granite block from the quarries of Maine, Massachusetts and Vermont, and in the last 30 years from the quarries of Georgia. The streets when paved were highly crowned, with curbing and counter curbing, forming deep gutters, bridged at street intersections, and of such width as to take care of quickly overflowed surfaces at times of sudden and heavy downpours and expected slow removal due to flooded low lands in the rear. Because of this construction the "sidewalk" was known locally as a "banquette."

As the city grew it naturally expanded up and down the higher portion of ground paralleling the river, and gradually broadened to the low lands in the rear. This extended city necessitated a better system of drainage; commerce and business monopolized the higher lands along the river bank, and the smaller business and residence sections had to locate in the lower ground to the rear. Large canals were dug and a system of paddle wheel pumps built to lift the water to give it sufficient velocity, but this system was ineffective for the growing city, and during and after heavy rains the lower portions of the city reaching toward the rear were for days flooded. From time to time scattered street paving was done throughout the city, with more or less success, but always attendant with the lack of drainage, or the necessity to provide very unsatisfactory surface drainage.

Because of soil conditions and the difficulties attending prompt and proper drainage it was for a long time assumed by many of the citizens that modern sanitary improvements could not be built in New Orleans. About 1900, however, there was an awakening to the realization that many of these so-called impossibilities were only the want of a comprehensive plan that could take care of the present needs and be extended for the future growth of the city. With this awakening and engineering study a plan was adopted that has since been carried out, with the result that the city enjoys all of the benefits of modern sanitary systems.

Prospective Street Paving Work

In the improvement of streets no extensive plan could be adopted, because during the construction of the sewerage, water and drainage systems, streets had to be almost constantly cut into all over the city, but within the past few years such a plan has been mapped out, a law passed that provides methods of small yearly payments by the property

owners, and work begun on bringing the street paving of New Orleans up to as high a standard as her other sanitary improvements. Previous to the war many streets were paved in the residence and business sections, but during the war all work had to be suspended. Efforts are now being made to continue with the street paving program, and bids for the work to be done in 1920 will be received about the middle of September.

How Pavements are Chosen and Paid for in New Orleans

Under the law the paving program for each year has to be prepared from six to eight months ahead of contracting; the property owners petition or the city on its own motion orders streets to be paved, and after usual formalities the city engineer prepares plans and specifications, advertises for various types of surfacing, and then the property owners, after bids have been received and tabulated and the price per foot figured out, select the type of surfacing. After this the city engineer estimates the amount of money required, and the city sells certificates. When these certificates have been sold contracts are signed and the contractor permitted to proceed with the work, and is paid cash in monthly estimates for the work done in the previous month, 20 per cent. being retained until the final completion and acceptance of the contract, with an additional 15 cts. per sq. yd. to guarantee maintenance for three and five years, respectively, for heavy and medium traffic streets, after completion and acceptance of pavement. These certificates, while a direct obligation of the city, act as a first mortgage lien against the property on streets where pavements are laid, and the property owners have the option of paying cash for the pavement or to extend the payments over a term of 10 years, at the rate of 4½ per cent. interest.

Should the property owners on any street select a type of pavement that would not in the opinion of the authorities be suitable to serve the traffic on that particular street, the city can designate the type to be used, and if costlier than the type selected by the property holders, paying the difference in cost out of the general tax fund. This permits the authorities to weigh thoroughly other considerations, such as ultimate cost figured by the probable life of the pavement; its durability by the occasion for minor but necessary and costly repairs and interruptions to traffic and business in congested sections, and many other factors of prime importance.

It is the duty of the city to maintain all pavements after the nominal maintenance required in the contract, at cost from the general tax fund, and at the same time bear the burden of complaining property owners, who are more likely to overlook their own shortcomings and call on the city to make good if after a few years' service the type of pavement they had selected has failed. Generally the city tax fund is a deficit for this purpose and, called upon for so many other needs, conditions grow from bad to worse until ultimately the street has to be resurfaced, with the attendant high cost, inconveniences, etc. Without this provision of the law the city would have to adopt the type of pavement most successfully promoted.

Old Granite Pavements Not Well Maintained

Of all paving materials granite has remained in service the longest in New Orleans, but unfortunately, streets laid with granite 60 or 75 years ago, after serving the purposes of those and subsequent periods, and repeatedly disturbed and replaced, often in the most careless manner, are sometimes judged as they are because they do not serve the requirements of the present day, all that which they have been called upon to answer and have answered in the development of the modern street pavements overlooked. That the granite pavements in New Orleans, both the old square block and the smaller Belgian block, are in an indifferent state of repair really emphasize the importance of granite as a paving material, because 95 per cent. of its value is there; in its life and usefulness many other types have completely failed and gone, still, because evidence of these failures is not present they are lost sight of and these same types of pavements by improved methods of production and laying are brought forward in competition with granite and granite is relegated to the primordial state of city street paving. In this enlightened age it would be fallacious were this prejudice permitted to persist; through the co-operation of the quarryman and the engineer improved methods of production and laying places granite on the same plane in these respects as other paving materials, and the same comparatives as well rule today that warranted our forefathers to select granite; conditions if anything being more intense and necessitating the most durable and wear-resistive material.

Old Belgian Block Pavements

Many years ago some streets were paved in New Orleans with the so-called Belgian block, principally from the Georgia quarries. The blocks were cut by unskilled laborers, and so long as they resembled a Belgian block, were acceptable. In laying no consideration was given as to size of blocks, joints, filler, etc.; they were rammed in place on a sand cushion, the joints filled with coarse gravel and sand; sometimes on a foundation, but more often on a sand cushion and natural foundation. As a consequence, these blocks have rounded at the joints, depressed, and so often disturbed on their base for the placing of various underground structures they more resemble cobble stone than granite block pavements.

Salvaging Old Granite Blocks

In the paving program for 1920 it is proposed to crush and use most of these and other old granite blocks for the mineral aggregate in the concrete for pavement sub-base. This value alone will approach $1.25 per sq. yd. salvage for the old pavements. Besides this value many of the old square stones heretofore have been used by the United States Government in jetty construction work, at a considerable saving in cost of material for that purpose. The greater amount of paving will be in the heavy traffic business section, and bids will be solicited on three representative types of pavements, one of which type is granite. The specifications of the city embrace all known improvements in modern street paving practice, and the specifications for granite block wearing surface is as follows:

Present New Orleans Specifications for Granite Pavements

Small Granite Block—Small granite block shall be of medium grained granite, showing an even distribution of constituent materials of uniform quality, structure and texture, without seams, scales and disintegration, free from an excess of mica or feldspar, and equal in every respect to the sample in the office of the City Engineer.

The granite shall have a toughness of not less than 7 and a "French Co-Efficient of Wear" of not less than 8. The said tests shall be made by methods prescribed by the U. S. Department of Agriculture, Office of Public Roads. The average of three tests shall be used for determining toughness and the average of 6 tests for determining the "French Co-Efficient of Wear."

Small granite blocks shall be made from 4 ins. to 4½ ins. in width and from 7 to 11 ins. in length, and from 4 to 4½ ins. in depth.

The blocks shall be so dressed that the faces will be approximately rectangular in shape, and the ends and sides sufficiently smooth to permit the blocks to be laid with joints not exceeding ½ in. in width and at the top. The top surface of the block shall be so cut that there will be no depression measuring more than ⅜ in. from a straight edge laid in any direction on the top and parallel to the general surface thereof. Care shall be exercised in handling the blocks so that the edges and corners shall not be chipped or broken, as blocks otherwise acceptable may be rejected on account of spawling.

Manner and Method of Laying

Small granite block roadway pavement shall be formed of a concrete foundation and a wearing surface of small granite blocks laid on the concrete foundation on a cushion course of sand and cement.

The cushion course shall consist of 1 part cement and 4 parts sand. The sand and cement shall be thoroughly mixed dry and then just sufficiently moistened to effect complete hydration. The cushion course thus prepared shall immediately be carefully and evenly spread by means of suitable templates, on the concrete foundation for an average of 1 in.; the thickness shall be permitted to vary slightly, depending on irregularity in the surface of the concrete foundation.

Blocks shall be sorted for laying in courses of uniform width.

If required by the special specifications an expansion joint of the width designated therein shall be provided along each curb.

As soon as the cushion course is in position, and before the cement forming part of the same has commenced to take its initial set, the blocks shall be laid thereon, at right angles to the curb line, except at intersecting streets, where they shall be laid at such angles and in such manner as the City Engineer may direct. All the longitudinal joints must be broken by a lap of not less than 3 ins., nor more than half the length of the block. The blocks shall be laid in the closest practicable contact with each other, the workmen standing on the blocks already laid, and in no case shall the cushion course in front of the pavers be disturbed or walked upon after being smoothed over and brought to exact crown and grade. After the blocks are laid, the end joints shall be made close and compact by the use of a steel bar applied at the ends next the curbs. At every fourth course, or as often as directed, the blocks are to be closed up and the courses straightened in a satisfactory manner. None but whole blocks shall be used, except in starting or finishing a course, except in such cases as may be specially directed or permitted by the City Engineer; and in no case shall less than one-half of a block be used. In the cutting and trimming of blocks, proper care shall be taken not to fracture the part to be used; the joints of all shall be at right angles to the top and sides.

Immediately after the blocks are laid they shall be thoroughly rammed by courses at least three times by a rammer weighing not less than 80 lbs., no iron being allowed on its lower face to come in contact with the paving blocks, and until brought to an unyielding bearing with a uniform surface, true to the established grade of the roadway pavement. The surface of the pavement thus completed must be even and smooth throughout and moulded to conform to street and alley intersections, drainage details and requirements and the grade and crown lines established by the City Engineer. During the final ramming the pavement shall be tested with a 4-ft. straight edge and any unevenness must be taken out and made true to the required grade, level and cross section. All unsatisfactory blocks shall be taken out with tongs and all low blocks shall be raised, and after additional cushion course material has been placed brought to an even and true surface by ramming. Pinch-bars shall not be used to remove blocks and no sand shall be placed in the joints except when mixed with cement as specified herein. All soft and chipped blocks which have been culled from the pavement and all other blocks which the City Engineer may deem unfit to be used shall be immediately removed from the street.

After the pavement has been brought to a true and even surface it shall be thoroughly wetted, without, however, using an excess of water, and then each and every joint shall be filled full to the surface of the pavement with a cement grout composed of equal parts of sand, or fine aggregate, and Portland cement, and mixed in a batch mixer approved by the City Engineer. The sand, or fine aggregate, used in the grout filler shall consist of clean, sharp grains or screenings from hard, durable rock, or gravel, preferably of silicious origin, free from vegetable or other deleterious matter and not containing clay in excess of 5 per cent. It shall be of such sizes that 100 per cent. will pass a No. 12 sieve, not more than 40 per cent. will pass a No. 50 sieve, and not more than 6 per cent. will pass a No. 100 sieve.

In proportioning the mixture the sand, or fine aggregate, shall be measured in a box having the same cubical contents as one sack of cement. The sand and cement shall first be mixed dry in the mixer, to a uniform color, then the proper amount of water added and mixing continued for not less than 12 revolutions of the drum. The grout first applied to the pavement shall be of a consistency to flow freely and to penetrate to the bottom of the blocks.

The grout as delivered from the mixer shall be immediately and rapidly applied in small quantities to the pavement and then swept into the joints with stiff brooms until the joints are filled to within 1 in. of the top of the pavement. After the grout has had time to settle into the joint, and within not less than 30 minutes after its application, the unfilled portion of the joint shall be filled with a grout of thicker consistency, and, if necessary, refilled until the joints remain full to the surface, or top, of the blocks. Extreme care shall be taken that the points are not cemented over, but that the grout extends down to the bottom of the blocks. After this last grout has had time to settle, and within 30 minutes after its application, the pavement shall be finished with a squeegee or wooden scraper having a rubber edge, which shall be worked over the entire surface of the grouted pavement at an angle with the courses of the blocks.

When completed and immediately after the cement has received its initial set, the pavement shall be covered for a period of one week with a ½-in. layer of sand, which shall be kept moist by being frequently sprinkled. No traffic shall be permitted on the pavement for a period of at least 14 days after grouting, or longer, if deemed necessary by the City Engineer on account of weather conditions.

Should the bond between the blocks become broken before the work is accepted the joints shall be cleaned out to the bottom, even if it is necessary to take up and relay the blocks. Such defective work shall be re-grouted or relaid and again barricaded as previously described.

In event rain stops the work before the joints are filled, the joints shall be protected by the use of tarpaulins, or by other equally effective means, to keep out water.

The period of maintenance for this character of pavement shall be three years; and the amount the Commissioner of Public Finance shall retain to guarantee faithful discharge of said obligation shall be 15 cts. per square yard for each square yard of pavement laid.

Concrete Base

The specification for foundation of granite block is the same as for other types of roadway pavements, to be of concrete 6 ins. or more in thickness, as directed by the City Engineer, formed of cement, fine aggregate and coarse aggregate in the proportion of 1:2½:5, the method for measuring the materials, including water, such as to insure separate and uniform proportions of each, and mixed in a batch mixer for not less than one minute before any part of the batch is discharged from the drum.

Specified Method of Placing Concrete

The method of placing concrete is specified to be as follows:

Immediately prior to laying the concrete foundation the sub-grade shall be carefully checked and any displacement of the materials composing the sub-grade that has been caused by teaming, or from any other cause, shall be corrected and the sub-grade shall be placed in its original condition. If deemed necessary or advisable in order to prevent drying of the concrete, the sub-grade shall be sprinkled (unless already damp) with water. While concrete is being placed particular care shall be exercised to prevent disturbance of the finished sub-grade. The laying of concrete on a muddy sub-grade is expressly forbidden.

Steel grade pins for the placing of the concrete will be set by the Assistant Engineer and the Contractor shall furnish the necessary pins and competent assistance to place them in position. The steel pins shall be placed across the street not more than 5 ft. apart. They shall be be set with their tops 2 ins. higher than the surface of the concrete so that they may be readily seen and pulled out when the concrete has been shaped around them.

The placing of concrete during freezing weather shall not be permitted.

After mixing, the concrete shall be deposited rapidly upon the sub-grade to the required depth and for the entire width of the pavement in successive batches and in a continuous operation. The concrete shall be deposited in a layer slightly thicker at the center than that finally required so as to procure a dense and uniform mixture. Whenever the placing of concrete as a continuous operation shall be interrupted by reason of stopping at the noon hour or at the end of a day's run or on account of adverse weather conditions, the concrete shall be laid up to and against a form or board placed in a vertical position, at right angles to the center line of the street and for the full width of the foundation, at the point of the sub-grade at which the concrete foundation is to be stopped. The vertical face so formed at the end of the concrete foundation shall be thoroughly wetted before fresh concrete is placed against it.

After depositing, the concrete shall be shaped or struck off by using such appliances or tools as may be approved by the City Engineer.

After the concrete has been struck off to the true grade and within 30 minutes of the time the concrete has been mixed, it shall be thoroughly floated or tamped in a manner to thoroughly compact it and to bring mortar to the surface and to produce a surface free from depressions or inequalities of any kind.

Grade pins shall be removed as soon as possible after the concrete foundation has been laid, and the holes filled with concrete.

The surface of the pavement shall be sprayed with water, as soon as the concrete is sufficiently hardened to prevent pitting, and kept thoroughly wet by means of a hose or approved sprinkling cans at all times during the five days immediately following the laying of the concrete. An adequate force must be provided by the Contractor, during the time required, to insure the concrete being kept wet. When the average temperature is below 50 degrees Fahrenheit, or during continuous wet weather, sprinkling of the concrete may, upon authorization from the City Engineer, be omitted.

No traffic shall be permitted to pass over the concrete foundation for a period of at least 14 days after the concrete has been deposited. The barriers protecting the work shall not be removed except upon authorization from the City Engineer. The Contractor will be held responsible for any damage resulting from traffic or other causes due to the removal of the barriers before the end of the 14 days' period, except when removed by special written order of the City Engineer.

All street paving construction in New Orleans is done under the supervision and direction of the City Engineer's Department, Mr. Thos. L. Willis, City Engineer. Prior to his appointment, Mr. Willis was for some years Assistant City Engineer, to Capt. Wm. J. Hardee, deceased, and then Engineer of the Municipal Repair Plant, in charge of the maintenance of all street pavement. During his administration of the Municipal Repair Plant this department did a considerable amount of repair, re-surfacing, construction, etc., of various kinds of street pavement.

Should granite block be selected to be laid on some of the streets to be paved in 1920, and constructed in all detail in accordance to the specifications above quoted, a pavement should be produced that will be uniform in appearance, wear smooth, and answer all the requirements of traffic.

Comparative Cost of Maintaining Roads with Tractor Outfit and Eight-Mule Outfit

By N. C. Hughes, Jr., Highway Engineer, Laurens, S. C.

Herewith are some definite data on the difference in the cost of maintaining roads with a tractor outfit and its nearest equivalent, an 8-mule outfit, as observed by the writer when engineer for the Cherokee County Highway Commission at Gaffney, S. C. The type of Lauson tractor employed is here illustrated.

Experience has taught me, however, that, given a system of highways to maintain, either an all-tractor outfit or an all-team outfit is an unbalanced proposition. Both, in my judgment, are needed to co-ordinate each other, for there are certain cases arising in the maintenance of roads which one or the other

LAUSON TRACTOR DRAWING GRADER FOR CHEROKEE COUNTY HIGHWAY COMMISSION, GAFFNEY, S. C.

will not prove suitable to handle. I could give some specific instances to substantiate this, but it is hardly necessary now.

Following are some cost data, taken from our daily cost and progress card:

Tractor Outfit

One 15-25 tractor, 2-7 ft. blade road machine. Progress: Machine, 9 miles 4 breadths of blade in 10-hr. day. Operation cost per diem, based on 24 work days in 30-day month:

Kerosene, 20 gals. at 15c	$ 3.00
Gasoline, 1 gal. at 26c	.26
Oil, 1 gal. at 75c	.75
Interest on equipment	1.00
Repairs	1.00
Engineman	3.50
Machine operators—1 at $4.50, 1 at $3.00	7.50
Total cost per diem	$17.01
Cost per mile at 9 miles per day	$1.89

Eight-Mule Outfit

Eight mules, 2 Standard road machines. Progress: Machines, 10 miles 4 breadths of blade in 10 hrs. Operation cost per diem, based on 24 work days in 30-day month:

8 mules at $1.25	$10.00
2 drivers at $2.50	5.00
Interest on equipment	1.00
Repairs and shoeing	1.80
Machine operators—1 at $4.50, 1 at $3.00	7.50
Total cost per diem	$25.30
Cost per mile at 10 miles per day	$2.53

When using a 3-way drag or leveler:

The tractor will cover 9 miles twice over in 10 hrs.

At a cost per diem of	$12.01
At a cost per mile of	1.334

A 6-mule outfit will drag 10 miles twice over in 10 hrs.

At a cost per diem of	$18.00
At a cost per mile of	1.80

When the occasion demands the use of a scarifier, one made to attach to an engine-drawn road machine, there is no comparison between tractor power and mule power then, the difference in the cost of operation being so much in the tractor's favor.

The above figures are based on facts and not on theory.

Recommended Procedure in the Construction of New Macadam Roads

By M. D. Ross, Division Engineer, Department of Public Roads, Newport, Ky.

The macadam road of today differs considerably from the one built by McAdam, although the fundamental principles demonstrated by McAdam that the foundation must be properly drained, and the water kept entirely away from the road, and that the aggregate of broken stone can be made to cement, or knit together and form a firm water-proof surface to support traffic. This still holds good today in new macadam construction, although with our modern machinery and scientific methods many changes have taken place.

When we consider the many different methods in constructing macadam roads (we will say water-bound macadam) for any macadam road at the present time must be water-bound if consolidated and bonded properly, there has been so much written, and it has been discussed so freely, it seems there would be little need to consider it at this time; nevertheless, it is not uncommon to see macadam roads under construction where little attempt is being made to observe the simple and well known principles of road construction, and that is perhaps sufficient reason for some discussion of those principles at this time.

Characteristics of Properly Constructed Road

The well known characteristics of a properly constructed water-bound macadam road are:—a well drained, carefully shaped and thoroughly compacted sub-grade; properly shaped shoulders and ditches to insure the removal of surface water, and a layer of thoroughly compacted, properly bonded crushed stone, the surface of which has been well keyed together by rolling so that it represents a compact mass of stone of sufficient size to bear the loads that will pass over it without crushing, and in which the stones are mechanically locked together by rolling and held in place by means of dust from the crushed stone which has been worked into the crevices between the stone by means of water and rolling.

Maximum Grade

As a properly constructed water-bound macadam road is a costly investment, careful consideration should be taken to make the important features permanent. The fixing of the maximum grade will be governed by at least two conditions: one the amount of the load that can be hauled over the grade, and the other the cost of maintenance. It has been conclusively demonstrated that grades should not exceed 5 per cent., on the other hand when possible, there should be enough grade to secure ample drainage.

Drainage

Great care should be taken to see that all drainage is such as will not cause failure of the road; if the sub-grade becomes water soaked it should be drained by means of tile sub-drain. The side ditches should be ample to carry the heaviest flow of water and a wide shallow ditch is preferable to a deep narrow one, they are much easier to construct, cheaper to maintain and are not dangerous to traffic. All ditches should drain to a natural drainage point, through a culvert and away from the road.

Width

A well constructed macadam road will have a width of at least 26 ft. from center to center of ditch in cuts, and at least 20 ft. from outside to outside of shoulders on fills, figuring 9 to 14 ft. of metal. At this point we will consider carefully the width of metal that should be used. This question is a much discussed one, some states have adopted 14 ft. as the least width of stone surface, some 12, and some 9; the width required depends altogether upon the amount of travel. For a good many of our roads in Kentucky 9 ft. of metal with a graded width of 20 to 26 ft. is ample; of course, a 9 ft. metal road will not, it is true, allow two vehicles to pass on the stone surface, but there are sections in some counties where it is comparatively seldom that two heavily loaded wagons have to pass, and where they do the shoulders offer a surface harder and firmer than the usual country road. This should be the minimum width and is only recommended where the heavy traffic is mostly in one direction. On the other hand, roads that are important and have considerable traffic in both directions, should never have less than 14 ft. of metal. This will allow two vehicles to pass each other safely, and if suitable earth shoulders are built on each side automobiles will have no trouble passing. If the stone is less than 14 ft. wide, there is a likelihood that the edges of the macadam will be sheared off by the wheels. The Department of Public Roads has figured that any width less than 14 ft. is waste of money and of little value, unless the surface is reduced to single track of 9 ft.

Equipment Used on Construction

In considering the construction of a water-bound macadam road the section used will be a 14 ft. metal surface. The equipment used in addition to picks, shovels and ordinary implements are a heavy construction plow for loosening the earth, wheel scraper for filling the low places and wagons for moving the earth any distance. Bottom dump or spreading wagons will save money, as they are used to advantage in spreading the stone, and often eliminating handling the stone twice. A scraping grader or road machine will be especially needed for shaping the sub-grade, ditches, etc. A steam roller of at least 10-ton size is indispensible in the construction of a modern road, both for preparing the sub-grade and rolling the broken stone. Water plays a large part in making the stone cement together so a watering cart or sprinkler of about 500-gal. capacity should be secured. The tires on it should be extremely wide; the sprinkling arrangement should be such that the water will be sprayed on to the crushed stone in a gentle, full and evenly distributed stream.

Unless it is cheaper to have the stone shipped from some regular quarry, or unless there is no suitable local stone available, a portable crushing outfit should be provided, consisting of a boiler, an engine, the crusher, and portable bins with a rotary screen and elevator to receive the stone from the crusher and to lift it into the screen from whence the different sizes are discharged into their respective bins. The crusher should be so arranged that the stone can be dumped on a platform

built around the mouth of the crusher, so that the stone can be fed into the crusher without further lifting, and the bins should be so arranged that the crushed stone may be loaded into the wagons by gravity. The plant should be located as centrally as possible to the work, if possible the crushed stone should not be hauled over a mile, yet at the same time it must be convenient to water, as a great amount is needed for the boiler. The size of the crusher should be such that the output will be from 75 to 100 cu. yds. a day, as the roller can easily roll this much each day.

Preparing the Sub-grade

Considering all fills and cuts having been made, and the sub-grade roughly prepared, then all spongy materials, vegetable matter, roots, stumps, etc., should be carefully removed from the roadway; nothing should be used but sound earth. The cross-section of the surface, slope, etc., is as follows:

In cuts the side slopes should be at least 1 to 1 and for a 14-ft. metal surface the width between center of ditches should be 26 ft., which includes 14 ft. of metal, 3 ft. for each shoulder and 3 ft. to the center of each ditch.

The slope of metal surface should be ½ to ¾ in. vertical to 1 ft. horizontal, the 3 ft. from the edge of shoulder to center of ditch should have a fall of 4 ins. to 1 ft., a total for 3 ft. will be 1 ft. depth of ditch. The only difference in section for fills is the 3 ft. slope from shoulder will run from 3 to 1 slope into 1½ to 1 slope, all fills will naturally slope 1½ to 1, making the total width from outside to outside edge of shoulder 20 ft.

In preparing the sub-grade for the broken stone if trench excavation is adopted most of the dirt to be moved in making this trench can be plowed and thrown out with an ordinary road grader at small expense, the width of the trench should be the same as that of the macadam, or 14 ft. and the depth the thickness of the bottom course of macadam.

Usually in constructing the sub-grade, with proper use of the road grader having the blade at such an angle as to cut half the required width of surface to be metaled, sufficient material is left on the side to form the shoulder for the macadam, this sub-grade can be properly crowned and brought to the proper cross section by adjusting the blade to the right angle.

After the sub-grade is shaped to the approximate cross section it should be rolled thoroughly until it is hard, firm and smooth. If soft places are found or depressions develop during the rolling, more good material should be put on. Remember that the sub-grade should be shaped and rolled properly, bumps and hollows left in the sub-grade will show up in each succeeding course. After the sub-grade is made it is very important to have drains cut through the shoulders (at intervals of 50 ft.) to the side ditches; this may save many days work and will keep the sub-grade dry when otherwise it would be flooded at every rain.

After the roadway shall have been graded with reasonable care, the surface upon which the broken stone is to be placed, must be hard, smooth, and carefully crowned to the same section as the finished roadway will assume.

First Course

After the sub-grade has been prepared for a few hundred feet, the spreading of the first course of stone should be commenced. This ordinarily consists of stone broken to sizes of from ¾ in. to 3½ ins., and should never be larger than 3½ ins. for our ordinary local limestone. In macadam construction where harder rock exists the maximum dimension is limited to 3 ins. This is so because the soft stone will often crush under thet roller to a greater extent than the harder. Any stone larger than 3½ ins. in any dimension should be broken with a napping hammer. Stone for the first course need not be of especial hardness or toughness. Ordinary limestone of any kind may be used. The thickness of the course (like every other feature of the road) varies with the local conditions. It has been carefully estimated by highway engineers, (for the average water-bound macadam road in Kentucky), and found that a thickness of six ins. loose will be the average, and should be mostly used; a course of 6 ins. can be thoroughly rolled with a 10 or 12-ton road roller. Any thickness over this is not advised as it cannot be consolidated properly.

This course should consist of a single layer of stone as specified, spread uniformly on the sub-grade; the metal should be dumped on dumping boards, unless spreading wagons or trucks of approved type are used. In spreading stone care should be taken to secure the required thickness and no more; the tendency seems always to use an excess amount. One way to prevent this excess is the use of wooden blocks about 6 ins. square with a height equal to the required thickness of the loose layer. These blocks should be used on each side and the center; the stone should then be leveled carefully to the top of these blocks. It is very important to have a good man in charge of the spreading as proper and economical spreading in many cases makes a saving of hundreds of yards of material per mile.

After one hundred feet or more of the first course of stone is spread and carefully shaped the rolling should commence. In rolling, there is one thing to remember; always roll the sides first, and when both sides are firm work gradually towards the center. This insures a uniform compacting of the stone, and finally roll until the whole surface has been rolled with the rear wheels, then there is no danger of spreading the stone. The roller should run as nearly parallel to the center line of the roadway as possible. If this rule is not followed the roller will mash the stone out flat and spoil the crown. There is no set rule as to how much the stone should be rolled. Experience will soon teach how much to roll any particular kind of stone; granite and other hard stone requires more rolling than do limestones, and in general the harder the stone the more rolling is required. In testing the stone to see if it has been thoroughly rolled one should be able to walk on it without causing much movement of the stone except just under the feet. All irregularities and depressions which may develop should be corrected with additional metal as the rolling progresses and the whole surface thoroughly compacted after such additions and corrections so that it is firm and true to the grades and cross-sections given. Screenings of sizes ranging from ¾ in. to dust should be spread with shovels from piles along the road side and in no case should the screenings be dumped on the surface. Screenings should be spread in thin layers and each layer rolled dry, this process being continued until the screenings are slightly below the surface of the rolled metal. Excess screenings should be scattered with brooms.

Second Course

In deciding upon the size of the pieces of stone to be used for the upper layer of a water-bound macadam road, the things to be taken into consideration are the quality of stone available for use, the amount of traffic, and the weight and character of the loads which will pass over the surface. With road surface carrying traffic made up of a great many heavily loaded horse-drawn vehicles, together with a large number of motor-driven vehicles, if the pieces of stone in the surface of the road are so small that the wheels passing over them crush them it is inevitable that rapid wear will result and that the road will destroy quickly. On the other hand if the surface of the road is made of large pieces of stone the traffic will not crush them nor even wear them with sufficient rapidity to supply fine material to fill the cracks between the stone and keep the voids filled, notwithstanding the action of the elements and traffic. In such a case the road will become rough and uneven, the surface being made up of rounded stones which project slightly and make it disagreeable to traffic. Considering this, it has been found with the limestone availabe, the size ranging from 1½ in. to 3½ ins. is most satisfactory. When stone of this size is used it is, of course, desirable to have the surface layer made up of fairly uniform pieces and should be screened as closely as possible to these sizes.

The second course should be spread with blocks to a depth of 4 ins. (the thickness of the course loose) as after careful consideration of the quality of our local stone and traffic conditions this thickness has been found most satisfactory. This course must be spread the same width, with same care as the first course and rolled in the same manner. In commencing to roll the second course the outside of the wheel of the roller should rest half on the shoulder and half on the stone so as to keep a uniform cross slope to both, and to pack the shoulder in order to keep the stone from spreading. Whenever possible the shoulder should be rolled for a distance of at least 2 ft. from the stone, at this period of the road's progress. Roll as before from the sides to the center until the stone is firmly in place so that a gentle kick will scarcely dislodge a stone and the surface is firm and even. Any depressions or bumps in the stone should be level or filled with additional stone (of same size as the rest of the course) and all wheel tracks smoothed out and the roller run over such places until the surface is hard and smooth.

Third Course

After the second course has been consolidated to the proper cross-section, the third or binder course should consist of stone screenings varying from ¾ in. in size to dust. Limestone screenings are generally used in this construction as the same material comprises the other courses, although sand and gravel has been used for binder for some rock with good results. The screenings should be spread from wagons or from piles alongside the road. They should never be dumped directly on a stone surface. In applying screenings a quick jerky motion is necessary, so that a shovelfull goes over a large area. They should be spread in thin layers, and each layer rolled dry, this process being continued until the screenings are flush with and not above the top of the rolled metal. If screenings are spread before the stone has been thoroughly rolled they only serve to separate the larger stone. The resulting surface is made up of individual stones set in pockets of screenings and is not as durable as one made of stone firmly locked together by rolling before any screenings are spread. All excess screenings should be scattered with brooms.

After spreading the screenings as described the road should be thoroughly sprinkled with water from the sprinkler to wash the screenings into the voids in the stone. Water thoroughly until it bubbles and flushes or rises to the surface as this shows that the voids in the stone have been properly filled. Follow the sprinkler with the roller and roll well, sprinkle and roll until the roller following close behind the sprinkler has a wave of water continually going before the wheels. This flushing may cause the dust to settle and bare spots to show up; cover these with more screenings, wet and roll until the surface is firm and hard and uniformly covered with a thin coat of dust. Don't make the mistake of using too much screenings; if more than just enough to fill the voids and cover surface is used, it will cause ruts under traffic and water standing in them will soften the surface and the result would be destruction of the road. After a section of road has been flushed and finished as above described, it should be left to set and dry out and then watered and rolled so as to make a thorough bonded surface. The surface when completed should present a granular surface with no excess of screenings and should be so hard that a piece of rock will crush beneath the roller, before penetrating the surface.

When a section of road is finished the road grader should be used to go over the shoulders and all surplus dirt removed until the road has as nearly as possible the cross section that the finished road should assume; by setting the blade to the proper slope, this can be readily done with little expense. Then the finished macadam road (with 6 ins. of loose metal for first course and 4 ins. for second course) should be, if properly rolled and bonded, a compact mass of metal approximately 7 ins. thick. It has been figured that 7 ins. compacted metal built on a proper sub-grade is sufficient to take care of the average traffic. The method of constructing a macadam road as outlined above, will be found in the General Specifications gotten out by the Kentucky Department of Public Roads, and if followed closely the best results will be obtained.

Acknowledgment

The foregoing paper by Mr. Ross was presented before the University of Kentucky Road School.

Some Things Learned in the Construction of Sand-Clay Roads

By W. S. Keller, State Highway Engineer, Montgomery, Ala.

Generally speaking the older an engineer gets the more thoroughly convinced he becomes that he does not know it all, as he used to think he did, and that in road construction in particular, something new and beneficial can be stored up in his bin of knowledge every day. The development of new ideas verified by experiments and tests are not confined solely to high class paved roads or to roads treated with oils, tars or other binders and dust preventives.

Even the humble earth road presents problems that are worthy of careful and painstaking thought, for after all for many, many years to come a vast part of our road system will remain unsurfaced. Next to the earth road and the one we desire to comment on particularly is the sand-clay road. This road has leaped into prominence within the past ten years and thousands of miles have been constructed. It would be idle talk to say that they are not of great value and will not be the popular road of vast areas of the South for years to come. Especially will this be true so long as freight rates make the importation into the sand-clay territory of better surfacing material, prohibitive.

Just what are the objections to sand-clay roads and what are the good features? Certainly there are both, else there would not be counties that have discontinued the construction of such and others that are perfectly satisfied with this homely highway.

Misuse of the Type

Unfortunately little consideration has been paid the character and volume of traffic before the type of road is decided on. What unquestionably is good for the rural districts is not necessarily suitable for populous sections, yet some road commissioners consider a road is a road and if it is good in one place it must be good in another. Acting on this false hypothesis sand-clay is used for surfacing roads through populous areas and even the streets of towns and cities with the inevitable result of dissatisfaction. Truly sand-clay is good in its place, but it must be kept there. That such roads should be condemned entirely is unreasonable and to, say the least, shows bad judgment. For a county road carrying a reasonable amount of traffic daily, reasonable in tonnage as well as number of vehicles, this road is quite satisfactory.

Steep Crown is Ruinous

The principle objections offered are that it becomes sloppy in wet weather and dusty in dry weather. That some such roads do become sloppy cannot be denied. The depth of ruts depends to a very great extent on the character of the sand-clay surfacing and the amount of maintenance such roads have had. Too much care cannct be exercised in the selection of this surfacing material and the mixing, where mixing is required. Often varying sections of good and bad surfacing can be seen in one continuous piece of road not exceeding two miles in length, showing clearly no judgment was exercised in the selection or test of material. One of the things experience has taught us is that one of the best ways to ruin what would be a good sand-clay road is to crown it to death, and literally this is true. The road is killed and its remains are washed into the side ditches leaving only its ribs for a driving surface.

The nature of the material, 65 to 80 per cent. being sand, should be a warning against such practice. Just sufficient crown to permit the water falling on the road to shed gently, is good practice. Alabama standard sections provide for a fall of ½ in. to the foot from center of road to edge of road bed, and 1 in. to 4 ins. from this point to center of ditch. The importance of having a good wide shallow ditch rather than a narrow, deep barrel-shaped ditch cannot be too strongly emphasized. Sand-clay roads are, of course, in sections where the soil has a large percentage of sand in it and naturally such soil washes easily. The broad ditch lessens the tendency of deep erosion and side washes, besides eliminating danger to the traveling public.

Good Width Means Long Life

Another lesson we have learned is that a good width means long life to this character of road. Our standard width of crown is 24 ft., and our width of ditches is 6 ft. We provide for a variation in the width of ditches according to soil condition, but generally the width is fully 6 ft. Grassing slopes is very important. Bermuda grass grows well in sandy soil and is the salvation of washing fills. It should not be planted on shoulders, especially in cuts as it grows rapidly and will soon choke up the ditches.

One of the good features of the sand-clay road is that it is less expensive than any other kind of surfaced road, the material for construction and maintenance being close at hand. Another good feature is that a well maintained road of this kind is most pleasing to all kinds of traffic.

Unquestionably the objectionable feature most often complained of, that it is "sloppy," can be reduced to a minimum by the frequent use of a drag during wet weather.

Some good roads crank will, one of these days, find a road

Some good roads crank will, one of the days, find a road

oil or some other material that will preserve this popular road and he will be called "blessed" by the common people.

News Letter from the American Association of Engineers

Unexpected enthusiasm and wide-spread interest in the work and plans of the Association are found by President F. H. Newell, of the American Association of Engineers, in his visit to the centers of engineering activity, particularly in the middle and far West. The young engineers, notably those recently returned from army or navy service, are putting their surplus energy into the upbuilding of the local clubs and chapters. Retaining some of the enthusiasm of larger service they see home affairs from the broad viewpoint of the traveler and are not content with the narrow vision of their older associates. They want to join in state and nation-wide activities as well as in those of their own town. The A. A. E., with its wide spread organization, has an appeal to their imagination.

The principal cities recently visited by Pres. Newell are Boston, New York, Philadelphia, Baltimore, Washington, Pittsburgh, Buffalo, Cincinnati, Dayton, Omaha, Kansas City, Denver, Salt Lake City, Boise, Seattle and Portland. He is arranging other meetings with the engineers of Sacramento, Los Angeles, San Francisco, San Diego, Tucson and El Paso. At each point visited conferences have been held with the local officers of A. A. E. followed usually by open meetings to which the public is invited. And when the results and plans of A. A. E. are explained and discussed, especial interest is shown in the studies of conditions of engineers.

In general there is a good demand for engineers, and works as a whole are being undertaken at a steadily increasing rate. The greatest activity is in highway building. In this time there is a scarcity of experienced men. Some money is being wasted for this reason. The general enthusiasm for hard roads on the part of the public may have a severe setback when the fact is discovered that many of the politically-appointed boards or supervisors—not engineers—are wasting funds on experiments or schemes not approved by skilled engineers. Here is where the local chapters of A. A. E. have much difficult work "cut out for them," namely, in educating the public of the dangers of neglect of competent engineering advice, or of permitting the employment of cheap men in responsible places. The public will not discriminate, and when the roads or bridges fail, as many must, the blame will fall inevitably on the engineer. Even though today he protests, if he does not make this protest loudly and effectively, it will not do to say later, "I told you so."

A committee to investigate the compensation of municipal and county engineers, and another to make a similar investigation for engineers employed by public utilities is being organized by the American Association of Engineers. The committee personnel has not been determined entirely, but it is expected that this will have been done very soon.

The American Association of Engineers has grown so fast during the last six months that the national headquarters of the Association in Chicago has outgrown its quarters. These headquarters have been moved from 29 So. La Salle St., to the Nepeenauk Building at 63 East Adams St., where a lease has been taken on 6,000 square feet of office space. The Chicago Chapter, which has over 1,100 members and which is now the largest engineering society in Chicago, will take over the space vacated by the national headquarters of the Association.

As a result of the recent affiliation of independent engineering societies with the American Association of Engineers, of which the Oregon Society of Engineers is the most recent affiliate, inquiry has been made by a member of the Louisiana Engineering Society concerning the possibilities of a similar affiliation, and requesting to be advised of the advantages which accrue to a local organization through amalgamation with A. A. E. For the benefit of other societies who may be interested it is announced that through such affiliation a local society gains a broader field and becomes a part of a national organization without losing its own autonomy. It is through such arrangements that engineers will eventually be united in thought and in action, and it is not until engineering effort is correlated through a single organization that the hopes of the profession will be realized. Five hundred independent engineering societies accomplish only small results, but let their efforts be co-ordinated into one national effort and the effect will be that of a load of buckshot fired from a single barrel.

Further Comment on Why Some Chicago Municipal Engineers Joined a Union

To the Editor:

There appears to be a universal movement among engineers to better their position financially, socially and professionally. At present emphasis is upon the financial status. The important question agitating the rank and file of the profession is the best means to achieve a financial readjustment bearing some reasonable relation to the compensation of other *workers* and adequate to meet the high cost of necessities. It is, first of all, obvious that results can only be secured by organization and co-operation. It is apparent that the form of organization must be adapted to the members, nature of their work and the relation of their work to society and our present industrial condition.

Engineering is a composite work. Certain super-phases are truly professional in character, but the majority of workers engaged in engineering or allied work are really skilled workmen. Modern practice in specializing tends more and more to build up distinct groups doing routine work. This work may require high technical qualification and some original ability, but because of its prescribed limits it restricts the worker to

his special field. He becomes then, in his relation to fellow-engineers and to society, a skilled workman. There are two classes of so-called engineers, the independent, consulting or employing engineer, and, secondly, the great mass of subordinates or employes. In a democracy the line of division between the two classes is not defined. Every one is free to rise to eminence, but of course, in the nature of things, few can or do. The great mass is destined to occupy permanently a minor but necessary position.

What form of organization can help the great mass? The typical engineering society is composed of members of both groups of engineers. Because of their superior merit or ability the government of these societies is controlled by the first group of so-called professional or "arrived" engineers. Their sympathies are with their own class and all they deign to offer is the elusive hope that you may one day be able to join their charmed circle. This situation makes it difficult for the great mass to receive recognition and support. The older engineers regard their early experience as an apprenticeship, but for the great mass it is the permanent state. It is but natural for the great mass of "engineering laborers" to want their own organization, controlled by them and in sympathy with their work and its necessary limitations. For self-protection and advancement they must organize. Where engineers are employed by large corporations or are in public service, organization is their only hope, not only because of securing adequate pay, proper working conditions, but of eliciting respect from those whom they direct or associate with. Unless present engineering societies can reorganize and recognize the needs of the *different classes* in engineering work, the trades union appears to offer the only asylum for the long-neglected engineer or "technical tradesman."

Many have taken the step of organizing a union of common workers and affiliating with the American Federation of Labor. Whether this affiliation is better than a reorganization within the engineering societies is a matter only time can tell. However, the union appears to be the only successful agency at hand. The engineering societies have virtually compelled the great mass of engineering employes to seek union help because of their own apathy born of the smug satisfaction of their leaders. Too long has the engineer been the football of industry.

The engineering employes of the city of Chicago have joined a union affiliated with the American Federation of Labor. They have been recognized, and are now being paid the union scale. The union appears to be the only refuge where employes are classed in groups and appropriated for at a uniform rate. Where individual efficiency is not recognized, as obtains generally in industrial and particularly in public service, and where the pay is fixed and uniform, the trades union organization alone, at this time, offers any hope to the so-called "struggling" engineer.

Very truly yours,

A CHICAGO MUNICIPAL ENGINEER.

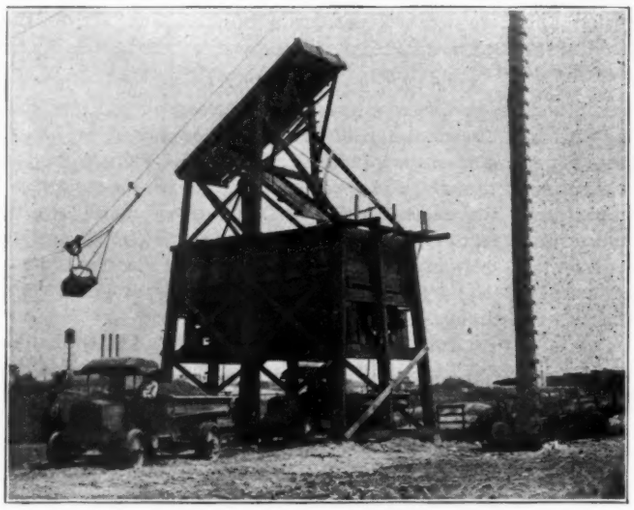
Chicago, Ill., Aug. 7, 1919.

City of Indianapolis Installs Own Gravel Plant

With 230 miles of gravel and unimproved streets to be smoothed and graveled, the city of Indianapolis has established its own gravel plant on the White river, near the heart of the city.

The plant consists of a ¾-cu. yd. Sauerman Dragline Cableway Excavator, operated by a Thomas 50-h.p. electric 2-speed hoist. The cableway spans the river, excavates material from the bed of the stream and conveys the material to the top of the gravity screening and storage plant shown in the illustration. The boulders are rejected and the material separated into sand and gravel by the gravity screens. The capacity is 180 yds. of gravel in 8 hours and a lesser quantity of sand, which is used by the city asphalt plant.

Street Commissioner A. I. Meloy this spring mapped out a 3-year program of improving the gravel streets and putting the unimproved streets in a passable condition. An appropriation of $17,814 was made to buy gravel for this season's portion of the 3-year program. It was then that Mr. Meloy set about to investigate whether the city could not save considerable money in the long run by operating its own gravel plant. The result of his investigation is the present plant, which has cost



SAUERMAN DRAGLINE CABLEWAY EXCAVATOR CONVEYING GRAVEL TO BINS AT INDIANAPOLIS MUNICIPAL GRAVEL PLANT.

the city about $5,000 and which produces enough gravel to carry out the improvement program at a cost of $9 per day for operator, laborer, electric power and oil. It is estimated that there is enough gravel in the river where the plant is situated to supply the city with gravel for the next 15 years.

A further saving has been effected by purchasing four motor trucks with dump bodies, doing away with the old-fashioned method of hauling by team. Mr. Meloy estimates that each of their gravel trucks will do an amount of work every day equal to eight teams. The eight teams would cost $44.80 per day, he says, while the truck costs only $6.20 per day, exclusive of depreciation and interest on investment.

Raising Funds to Pay for Roads

By James I. Blakslee, Fourth Assistant Postmaster General, Washington, D. C.

One of the greatest difficulties that confront the advocate of good roads in this country, is the cost of construction and payment therefor. I have participated in numerous movements for the betterment of the highways. I have heard splendid orations about how to build a road, but I have failed to note any concrete declaration of a satisfactory method of raising funds to pay for the construction of good roads, or to meet the expenses of the improvement and maintenance thereof, except through the use of Federal or local taxes. Forthwith dissension arises. For, whenever the general public is expected to pay for the construction of a particular highway, traveling through territory remote from the domicile of the taxpayer, the larger the taxpayer, the less enthusiasm is evidenced, for he feels that he is not receiving adequate direct returns from the investment that he has made in the highway.

Those Who Use Roads Should Pay For Them

I have, before this time, proposed that the greater portion

of the cost of construction and improvement of permanent highways, should be borne by those who use them, and I have endeavored to illustrate how, through the increased use of the highways by the Federal government in a profitable enterprise, this cost of construction and expense of improvement and maintenance could be defrayed. I again present the proposition to you in a form that I trust will be easily understood.

Three Methods of Meeting Cost of Roads

I believe that there should be three different methods of meeting the cost of the construction and improvement of highways.

First: For a Highway Entirely Federal or National in Character: The Federal Government should defray the cost of construction, improvement and maintenance thereof as an interstate highway, available not only for the transportation of merchandise and food products, but, also useful for military purposes, and this *main line* or *through connecting National Highway*, should be utilized by the Federal government in the transportation of commodities upon which a revenue should be earned sufficient to meet the expenses of transportation, and to provide for the improvement and maintenance of the roadway over which the commodities are conveyed, and I submit a definite, specific method, one that we have tried and found profitable—the conveyance of mailable matter, including parcel post, at regular postage rates which are, at this time, sufficient to cover the cost of transportation, expense of administration, and the construction, improvement and maintenance of the highway used for such purpose.

There are transportation facilities in daily operation on *through* or *connecting highways* from Portland, Maine, to Richmond, Virginia; from New York City to Chicago; from Indianapolis, Indiana, to Montgomery, Alabama; and with an appropriation of $300,000, the postage revenues on these highways and adjacent roads leading to the same, now average over $2,000,000 per annum.

This concrete exhibition of the co-ordination of a governmental function such as the mail service with good roads, is more sufficient warrant for the encouragement of the greater extension of this program, than for any other that has yet been presented, and leads to the second method.

Second: For a Highway Supported by the Federal Government and the States and Local Subdivisions thereof: This method, one of co-operation in the improvement of highways, on a basis that is in effect at this time, is one whereby the Federal government participates with the states and local subdivisions thereof in the cost of construction and maintenance of highways, by paying one-half the cost thereof, and such expenditures should be made with due regard to the value of the highway in its relation to the *trunk line* or *National Highway*, heretofore mentioned. These highways should be known as *feeder highways* and located near *trunk lines* or *National Highways*, within producing territory, so that when mail facilities or other transportation functions may be established thereon, the revenues therefrom may be used to assist in defraying the expenses of construction, improvement or maintenance.

Third: For a Highway Supported by State, County or Township: This third definite suggestion includes the construction and maintenance of the dirt or gravel road, which should be borne by the local state, county or township, and would be utilized as supply roads to the *feeder* roads that finally connect with the *National trunk line roads*. These supply roads would, naturally, be used exactly as they are used today, mail facilities together with other means of transportation traveling over the same, collecting commodities from the outlying sparsely settled sections for transmission to *feeder* roads and thence to the *through National highway* to the larger urban centers that consume the products.

Now, in this proposition, I simply endeavor to illustrate, or to present to you, a definite, specific program of highway construction and maintenance, and a definite, specific method of defraying the cost of the same.

There may be other methods that are an improvement on this, or present a better or more desirable system, but until some such improved plans are forthcoming, it seems to me that the hearty co-operation and unanimous assistance of all those who are interested, directly or indirectly, in good roads, should be devoted to the promulgation of this program.

Profits

I shall concede to the conscientious objector that there are many points where this proposition may be attacked. I shall acknowledge that all the revenues derived as stated, are not to be credited exclusively to the particular service now in operation; that the matter transported could travel over other means of conveyance—perhaps not so efficiently, or safely, but none the less, travel. However, 50 per cent. is at least a fair proportion of such revenues that should be properly credited to the system of transportation now effective, and, even there, I know of few enterprises that upon an investment of $300,000 would be able to produce an annual income of $1,000,000, which is 50 per cent. of the whole income derived from this investment of $300,000.

Benefits

The benefits of the adoption of such a system of highway construction and improvement, are not confined to the enlarged revenues of the government, or the betterment of the roads alone; there is a still greater interest than either involved, and that is the convenience of the people. It is the value of the service performed. The benefits can be extended to include the cost of living, for, through the complete organization of a system of transportation facilities covering improved roads, commodity prices that have today reached exorbitant figures, can be influenced to a considerable extent; for, having established *through* or *connecting* roads as previously stated, it was our duty to ascertain in what manner such service could be utilized to a better advantage of the patron than simply the direct transportation of merchandise, and, in order to do so, we collected retail prices of provisions and produce of several different classes, at the 300 or more post offices located on or adjacent to the truck routes, and we found that on Oct. 22, 1918, fresh eggs were selling in the city of Newark, New Jersey—11 miles from New York City—at $1 per dozen, when a tremendous supply was available at New Holland, Pa., a distance of 100 miles from Newark, at 60 cts. per dozen. With a postal rate of about 3 cts. per dozen this indicated that if we had been able to provide adequate direct mail facilities from New Holland, Pa., to Newark, N. J., we could have possibly delivered this prime food product in that city at from 25 to 30 cts. per dozen less than the price the citizens were paying, and the price obtained at New Holland, Pa., was not the lowest price that prevailed at numerous other localities on the direct lines operating from Newark, N. J.

Consequently, when a complete system, properly equipped, is in operation, the revenues of the government will be increased and the cost of the construction and improvement of the highways will be defrayed.

But a far more desirable result will have been attained, and that is, we shall have supplied to the merchants in the city a means of conveyance for merchandise to the producer in the country, and shall have provided the residents in the city with a means of securing their produce, at greatly reduced prices, direct from the farmer.

Acknowledgment

The foregoing is from an address by Mr. Blakslee before the Highway Traffic Association of the State of New York.

Present Federal Aid Will be Strengthened by a National Highway System

Farmers are asking their state highway officials and representatives in Congress for definite information concerning the national highway bill now pending in the United States Senate, and with a clear understanding of the national road project they are, in general, expressing their approval.

An impression is held in some sections that the continuation of Federal Aid will be adversely affected should the pending measure become a law, since it provides for construction and maintenance under exclusive Federal control on such highways as may become state links in the national system. The fear has been expressed that such a step would result in a lessening of Federal co-operation on purely state and county roads.

Senator Townsend of Michigan, author of the bill and chairman of the Senate Committee on Post Offices and Post Roads, is keeping in close touch with highway problems, particularly during this period when auxiliaries to railways and quicker methods of food product distribution are so urgently needed to check living costs. Noting this tendency toward fear that the national highway project might in some way affect adversely the present system of Federal and State co-operation, he has expressed the opinion with emphasis that the Federal Aid plan will in no wise be weakened. On the contrary, the Senator asserts that Federal Aid will be strengthened since roads are what the people need, and a greater mileage of permanent highways will be constructed and put into use in much less time under the proposed national highway plan than is possible even at the rate roads are now being built.

"The object of the bill introduced by me," Senator Townsend states, "is to establish and maintain a national system of highways according to a national plan connecting the different states of the Union, and affording an example of proper highway construction, which will be beneficial to the states. The bill does not in any manner injuriously affect existing law, in fact it provides that the Commission created under it shall have charge of the Federal Aid Law, and shall make reports annually to the Congress as to what is being accomplished under existing law, and to make such recommendations for the future as the operation of the law and its results seem to be necessary. The two systems of road building are separate and distinct, except that they are under control of the same Federal Commission. The appropriations, however, cannot be mingled, and the results will be known and properly appraised by the people from time to time. If the present Federal Aid Law proves satisfactory, it will as a matter of course, be continued, and probably enlarged. If the proven results are not satisfactory, that law will be discontinued. And what I say of the Federal Aid Law will be true of the bill now pending before the Senate. The Commission appointed under the law, it may safely be presumed, will be high grade men, representing different sections of the country, and their life-work will be to serve the people by furnishing the best possible highway transportation facilities."

Immediate Needs of the Engineering Profession

By James C. Patterson, Principal Assistant Engineer of the Erie Railroad in Addressing New York Chapter of the American Association of Engineers

For many years the necessity for a business association of engineers has been apparent. The engineer, although a creator of wealth and a pioneer in advancement of civilization has never been adequately compensated for his service. This has been largely due to the lack of initiative among members of the profession in organizing for their own protection and the betterment of their economic condition as other professions have done. But the steadily mounting cost of living and the concessions granted to organized labor from time to time have at last brought the engineer to a realization of the fact that he is facing a struggle for existence and that he must either take steps for self-protection or abandon his profession for a more lucrative line of endeavor. The needs of the profession are as follows:

Minimum Compensation for Standardized Positions

First, adequate and uniform minimum compensation for standardized positions as far as it is practicable to apply standardized rates to the profession.

The principle of standardized rates has been objected to in certain quarters on the grounds that it will destroy initiative and eliminate the incentive for good work which exists under the principle of bargaining between employer and employee and reduce the organization to the status of a labor union. This is apparently due to a misunderstanding of the situation. What is needed is a uniform classification of all engineering positions according to duties and responsibility and fix a minimum rate for each position. This is a task of magnitude, but is no greater than problems the engineer is called on every day to solve. This will insure each member of the profession living salary and gradation according to individual ability can be made above the minimum rate maintaining the principle of bargaining between employer and employee. This will not be alone a benefit to the employee. It will be of even greater benefit to the employer who through a false idea of economy insists on paying a rate so low that competent men cannot be secured and eventually loses through poor engineering many times the small amount saved in salary.

Licensing of Engineers

Second, registration or licensing of the engineer to eliminate undesirable practitioners and protect the public as well as competent members of the profession.

Just why a doctor or lawyer should be licensed and not an engineer is not apparent. Certainly their responsibility to the public can be little if any more than an engineer. There is scarcely a day of our existence that we do not in some way entrust our safety to some structure or device designed by an engineer. What we need is a uniform law for every state in the union which will eliminate the incompetent and protect the competent members of the profession; in no other way can the abuse of the title of engineer in that technical sense be eliminated.

Standard Code of Ethics

Third, promulgation and enforcement of a standard code of ethics. There are at present no rules governing the conduct of an engineer toward the public and other members of the profession. Unscrupulous engineers have taken advantage of this fact to exploit the work of subordinates for their profit, to disparage the work of another engineer in hopes of gaining advantake thereby and to secure assignments by underbidding rates which are just and reasonable. This cut throat practice works strongly to the disadvantage of the profession and can only be eliminated by enforcing a standard code of ethics which will result in such men becoming outcasts in the profession.

Employment Bureau

Fourth, the establishment of a central clearing house or employment bureau and the elimination of exploitation of the profession by private agencies.

Undoubtedly much assistance has been given to engineers by private employment agencies which has been worth the fees paid but on the other hand thousands of dollars in registration fees have been collected without doing the registrant any good. These agencies are regarded by both employee and employer as a last resort; resulting in the majority of the positions listed and the applicants therefor being undesirable. The great difficulty in a man marketing his services is to find

where the opening exists for which he is fitted. A central clearing house would be a great benefit in bringing the man and opening together.

As to the methods to be pursued in filling the needs of the profession is it believed that this can only be accomplished by a strongly centralized organization composed of engineers of all branches of the profession and devoted to the one object of bettering their social and economic welfare. To attempt to consolidate existing societies in the different branches of the profession is to bring together a number of unts each with somewhat different ideas according to the branch of the profession which they represent and who would probably become discordant elements making agreement on methods of procedure difficult. Again these societies are organized for technical discussion and have never really done anything effective toward bettering the economic condition of the engineer although the need has long been apparent. It is believed that they should continue to fulfill the function which they now perform and the separate organization should handle all matters of business.

With an organization of this character with a membership of practically the entire engineering profession it is believed that its moral effect will be so great that there will be no difficulty in securing the proper recognition for engineers. The American Association of Engineers has come forward and is filling the need of the profession and if each individual member will lend his support in increasing the membership there is every reason to believe that our problem will soon be solved.

Operating Experiences With Activated Sludge Process for Factory Wastes

By George W. Fuller, Consulting Engineer, 170 Broadway, New York, N. Y.

On the outskirts of Boonton, N. J., the E. A. Stevenson & Company, Inc., have a plant for refining crude cocoanut oil and the manufacture of cooking oil, soap bases and butter from cocoanut oil and milk products. The refined product is marketed for the most part as an edible oil of a melting point of 76° to 92° F. under the trade name of "COBEE" and as nut margarine under the trade name of "SPREDIT."

Character of Wastes

The average amount of combined wastes to be dealt with from the factory is about 150,000 gals. daily at rates ranging from about 30,000 to 300,000 gals. daily, and at an average temperature of 40°C. Some 100,000 gals. of clean hot condensing water was diverted to a nearby brook as part of the treatment program.

Refinery wastes, about 70,000 gals. daily, and discharged at rates varying from 20,000 gals. to 100,000 gals. daily consist for the most part of condensing water with which is discharged some 450 gals. of volatile oil. Some of this oil combines with caustic soda used in the process and forms a liquid soap. Probably 70 per cent. or some 315 gallons of this oil is recovered in the grease traps. These wastes are discharged every day of the year, 24 hours a day.

Charcoal is often and Fuller's Earth always present in these wastes.

The average temperature of the refinery wastes is about 50° C. but are often as high as 70° or more.

The dairy wastes discharged during 8 hours of 6 days in the week consist on an average of about 50,000 gals. of milk and churn wastes, containing some 1,000 gals. of buttermilk, 20,000 gals. of floor and apparatus washings and 1,400 gals. of acid wastes daily. Maximum rates are about double the average rates, although milk and churn flows are often three times the average. Dilute sulphuric acid from the digestors is discharged with these wastes intermittently in amounts varying from 700 to 2,000 gals. daily, the strength ranging from 100 to 3,000 parts per million. The actual rate of discharge is about 100 gals. per minute, the operator at the plant being notified in advance to allow him to by-pass them to the re-aerating tank for treatment.

Toilet and wash room discharges from the 200 employees at the factory amount to about 10,000 gals. daily.

Dairy wastes are conducted to the plant through a separate pipe and discharge into the inlet trough to the aerating tanks without preliminary treatment.

Former Disposal Experiences

Previous to the installation of the present treatment works, waste matters from the refinery and dairy and condensing water were discharged together into a grease trap of about 20 minutes' capacity at average rates. From this trap they were conducted to lagoons roughly formed with cinder banks, the discharge from which was over weirs protected by scum boards to hold back the grease and oils to a small brook leading to a mill pond and ultimately into the Passaic River. There was more or less sedimentation of the heavier matters, charcoal and Fuller's Earth, by this process and a large proportion of the floating oil was removed by skimming.

Toilet and wash room wastes were discharged to two cesspools which satisfactorily disposed of them.

Pollution of the brook resulted in complaints from property and mill owners and ultimately required improvements in the method of disposing of these wastes. The writer's firm was called upon late in the autumn of 1918 to advise as to remedial measures.

Recommended Process

The desirability of minimizing the investment for obtaining the necessary treatment of the wastes sufficient to avoid difficulty from a suit brought by riparian owners below as well as the restricted area of available land and the oily nature of the wastes brought about a decision against filtration as a fininshing process and a resort to the activated sludge process with such operating procedures as the local conditions demanded.

New Treatment Works

The plant as constructed consists of preliminary grease traps, aerating tanks, re-aerating tank, final settling tank and necessary operating appurtenances.

During the construction of the plant the jet condensers used in the refinery were replaced with surface condensers and this hot condensing water diverted through a new pipe line directly to the brook. This eliminated some 100,000 gals. of hot water which would have required cooling to prevent destruction of bacterial growths in the aerating tanks.

An attempt was also made to store and neutralize the acid discharge but this was later abandoned for the procedure described beyond.

The new grease traps supplementing the old one are in three units of a total capacity of about one hour's flow at normal rates or about 5,000 gals. They are each 10-ft. in length, 6½ ft. in width with a sloping bottom to flow-off drains allowing for an average depth of 3½ ft. wide.

The aerating tanks are in two units of a combined capacity of about 45,000 gals., each of them being 30 ft. long, 10 ft. deep and 10 ft. wide.

To insure thorough mixing of the activated sludge with the wastes treated, vertical baffles were placed across the aerating tank. The baffles are 3 ft. apart longitudinally, with a waterway 2 ft. deep, alternately above and below them.

The re-aerating tank is 30 ft. long, 5 ft. wide and 10 ft. deep and contains about 11,000 gals.

The final settling tank is of the Dortmond type to provide for a vertical upward flow. It is circular, 11.2 ft. in diameter, 10 ft. deep to the bottom of the cone and with capacity of about 6,000 gals. The sewage enters the tank through a 12-in. vertical trough enlarged at the lower end to about 2 ft. square;

the discharge is 6 ft. below the water level; the outlet is over weirs to troughs placed near the side of the tank.

Provision is made for the introduction of milk of lime at the inlet to the aerating chambers and also to the final settling tank. The former is to correct acidity and the latter to facilitate clarification.

Air is supplied from two motor driven No. ½ Root blowers, each of a normal capacity of 150 cu. ft. per minute at 5 lbs. pressure. Main air piping to the tanks is 4-in. wrought iron pipe with 2-in. drop pipes in duplicate to 1-in. air distribution grids. These distribution pipes are spaced 12 ins. apart, with 1/16-in. circular openings spaced 3 ins. apart and staggered on the lower quadrant of the pipe. Sludge is pumped by a 4-in. air lift discharging to a trough from which the sludge can be delivered either to the re-aerating or aerating tanks as desired. The blowers after operation for three months showed a serious reduction in capacity and arrangements are now being made for furnishing air from the main compressors at the factory and which with regulating valves will provide for an available pressure up to 100 lbs. if desired. This change will overcome irregularities in blower performance and assist in maintaining the air pipes free of clogging.

Clogging of the air pipes has been caused more by the settlement of heavy suspended matters around them during the early period of operation when experiments with humus, peat, etc., were being conducted, than by solid matters entering the openings in the pipe. Filtros plates and other similar devices were considered for air distribution but rejected because of the unusual quantity of grease and oil in the waste to be treated and which it was feared would clog the pores of the plates. While the comparatively large openings in the distributing piping compel the use of a greater amount of air than would have been the case with filtros plates, it also provides for ease in cleaning out these openings by the use of air under pressure. Experience has shown that it is always possible to remove any clogging matters by air pressures of 10 lbs. or over.

Preliminary Operating Experiments

On May 16, 1919, the plant was first started in a preliminary way with the intention of obtaining activated sludge from the contents of two cesspools which were emptied into one of the aerating tanks. The cesspool material amounted to about 11,000 gals. and represented the accumulation of some months, coming from the water-closets used by the 200 employees. There was some interruption in getting the mechanical equipment in smooth working order and very little was obtained as a result of the first month's operation. The cesspool wastes appeared to have been septicized to a point where it was difficult to activate the suspended matter.

Activation of Outside Material

Failure to obtain proper sludge from the cesspools resulted in a systematic effort being made to obtain activated sludge by using organic substances other than the factory wastes. Use was made of peat, humus, sawdust, horse manure and cow manure. Barrel experiments were made with these different substances alone and with the addition of washings from rich garden soil inoculated the organic material with nitrifying bacteria.

It was found that the use of peat presented difficulties caused by mineral matter which clogged the openings of the distributing pipes. In a measure the same was true of the straw mixed with the horse manure. Humus was tried but the expense was greater than for other materials and it was of such a texture that it was impossible to suspend in the liquid treated more than about 5 per cent., as measured by the volume of the sludge after 10 minutes' sedimentation.

Inoculation with washings from garden soil allowed a satisfactory sludge to be obtained in from 3 to 5 days with either peat or humus, and in not to exceed 12 days with cow manure or horse manure. Apparently these latter two materials require a longer period for activation on account of their anaerobic condition initially as compared with the aerobic condition of the peat and humus; without inoculation the sludge was ripened in 18 to 24 days, thus showing that inoculation with nitrifying bacteria materially hastened the activation process.

Combustion of Organic Matter

One of the interesting results obtained was the extent to which organic matter disappeared through wet combustion resulting from the oxidizing and nitrifying nature of the process. Studies were carefully made of available sources of organic matter which could be obtained cheaply and readily and which would be satisfactory as regards grit and fibrous products which would tend to clog the air distributing lines. It was finally decided that everything considered the best material to use is cow manure obtained from neighboring dairies. The volume required is about 8 cu. ft. per 24 hours for a flow of about 150,000 gals. of wastes. The water content of this material varies somewhat but probably averages about 70 per cent. This indicates a needed addition of dry organic matter of about 130 parts per million. The material is mixed with water in a wheel-barrow until in a liquid condition and then applied to the inlet section of the aerating tank. This is done about 4 times during 8 hours of the day or at the rate of about 1 cu. ft. of cow manure per hour during that period. No cow manure is added during the remaining 16 hours when no creamery wastes reach the plant.

Operating Program

Under normal conditions the flow is directed to one aerating tank to the amount of about 100,000 gals. daily. Quantities in excess of this flow to the second tank. Acid discharges occurring from one to five times per day are by-passed to the re-aerating tank and from there applied with the pumped discharge of limed sludge from the final tank.

The amount of air used is about 0.5 cu. ft. per square foot of tank surface per minute or about 1.5 cu. ft. per gallon of liquid treated. An aeration period of about 3 hours ordinarily seems to suffice and with peat a 2 hour period of aeration seems reasonably sufficient for short intervals. The amount of sludge is kept as nearly as possible to 20 per cent. as a smaller amount does not satisfactorily clarify the wastes and a greater amount requires additional expense for cow manure.

Final Sedimentation

After the wastes have been aerated and discharged to the final tank the supernated liquid is drawn off at the top and the sludge collecting in the hopper bottom is removed continuously by the air lift to the inlet distributing trough as previously explained.

It was found that plain sedimentation for the period available did not produce complete clarification and lime was added at the inlet to the final sedimentation tank at the rate of about 3 grains per gallon. This produces a clear effluent and the lime pumped with the sludge serves a double purpose in that it not only aids in precipitating suspended matters, but it also serves to correct the acidity which appears in the mixed wastes and which are by-passed to the re-aerating tank.

Quality of Effluent

The final effluent is not only well clarified and substantially free of fatty products, but is stable without dilution for a period of more than 14 days in stoppered bottles, subject to the methylene blue test at ordinary temperature.

General Considerations

The novelty of this process as applied under local conditions, will be appreciated when it is stated that the problem consists essentially of finding a material with which to build up sludge rather than that of encountering the expense of disposing of sludge as is usually the case; in fact the sludge beds on an adjoining cinder dump have not been used at all during the first 3 months of operation of this plant.

The average temperature of the mixed wastes, about 40°C., does not seem to be a handicap to this process, but on the contrary is probably a material factor in intensifying opera-

tions as indicated by the relatively short aerating period required as well as by the weight of organic matter which is actually burned out in the aerating tanks. An occasionally influent temperature of about 60°C., for a few minutes is of course not helpful, but the plant seems to recover during the interval between such occasions.

The process is also much less sensitive to acids than one might suppose, although it is a fact that it is somewhat interfered with at times, due apparently to acidity.

The process is greatly dependent on freedom from interruption of the air supply. This was demonstrated when on July 23, an extraordinarily heavy rain produced local floods which resulted in a suspension of the air supply on two occasions during the same day, one of them being for 8½ hours. This was sufficient for the sludge to lose its activation and become putrescible. It required aeration of about 7 days following this mishap to place the plant on a normal working basis again.

In spite of adverse local conditions this activated sludge plant shows that plants of this type will satisfactorily treat even so difficult a waste as this, and its operation shows that a satisfactory substitute for the suspended matters usually met with and utilized in municipal sewage treatment works of this type may be obtained from various materials outside of those contained in the sewage, the selection of the best material depending on local conditions as to availability and cost.

The plant has not been controlled with the aid of extensive laboratory tests, although at the factory there are reasonably satisfactory laboratory facilities. Working procedures have been developed on the basis of listing one after another the difficulties which arose with a description of remedial steps to be taken in each respective event. During the tuning up operations an experienced operator of sewage disposal plants has been sent to this factory several times each week in order to study its behavior and the effect on aeration of seeding with garden soil, the correction of acidity and use of lime, as well as the mechanical manipulation of the plant, and steps needed to control the wastes more effectively prior to their entrance into the aerating tank. This tuning up occupied a period of about 10 weeks.

Greater Attention to be Given to Highway Engineering Education

Commenting upon the report that Secretary Lane of the Department of Interior will shortly call a national conference on highway engineering construction in colleges and universities, Arthur H. Blanchard, Professor of Highway Engineering at the University of Michigan, says:

"Highway officials, progressive educators and many prominent business men realize that a serious condition will confront the United States and Canada if graduates of our technical schools are not properly trained in highway engineering. The phenomenal development of highway transport has created a demand for efficient highway improvement which can only be satisfied by placing highway work in the hands of competent engineers.

"Thoroughly trained and experienced highway engineers are needed to occupy the innumerable positions connected with the administration, financing, design, construction and maintenance of the 2,500,000 miles of rural highways and the thousands of miles of streets in the municipalities of the United States and Canada in order that highways may efficiently serve economic, social, transportation, agricultural, industrial, commercial, and military requirements. Highway appropriations will increase rapidly during the next five years as is indicated by the 1919 appropriations of $500,000,000 in the United States and a relatively large amount in Canada, for highway improvements and a widespread demand for the construction of a system of 50,000 miles of National Highways by the United States Government under the direction of a National Highway Commission.

"Estimates made this year by the United States Bureau of Public Roads disclosed a remarkable field of opportunity for highway engineers, as investigation showed that for federal and state highway work alone exclusive of cities, counties and towns, there are required 122 chief executives and administrators; 360 division engineers of the federal government, division chiefs of bureau, division chiefs of highway departments, district engineers of highway departments, etc.; 3,630 supervising engineers and chiefs of party, and 6,350 junior engineers, rodmen, chainmen, draftsmen and others of similar calibre.

"The consensus of opinion of eminent highway engineers and educators is to the effect that highway engineers should have the broad foundation which the four-year course in civil engineering gives. The Asphalt Association takes the definite stand that as much time should be given to the essentials of highway engineers as is given to sanitary, hydraulic or railroad engineering. The association will devote its educational campaign especially to institutions where either no courses or very short courses in highway engineering are given. The Asphalt Association has found that only 25 of the 93 colleges investigated give a satisfactory fundamental training in highway engineering as a part of the civil engineering course.

"The waste of millions of dollars annually in the United States will continue until the profession of highway engineering is placed on the same basis as structural, hydraulic, sanitary and other branches of civil engineering. England and France have seen the light. As a result, efficient highway engineers are retained in office, methods of construction and maintenance suitable for traffic requirements are employed and as a consequence the public funds are wisely and economically expended."

Professor Blanchard will co-operate with the engineers of the Asphalt Association in developing a plan with colleges and universities under which highway engineering courses of instruction will receive increased attention.

The end sought is that graduates of technical schools may be equipped properly to occupy the administrative, executive, business and engineering positions in national, state, county, town and municipal highway departments of the United States and in the Dominion, provincial and municipal departments of Canada.

Estimating for Asphalt Pavement Repairs

By J. O. Preston, C. E., Assistant Engineer Rochester Bureau of Municipal Research, Inc., Rochester, N. Y.

Highway engineering is approaching an exact science. As a general practice, maintenance of highways is less scientific than design and construction. The writer developed the following method of estimating the repairs for asphalt pavements in Rochester, N. Y. This system is another phase of the control of repairs outlined by J. W. Routh in the November, 1918, issue of MUNICIPAL AND COUNTY ENGINEERING, under the title of "The Maintenance of Asphalt Pavements by the Cut and Replace Method."

Purpose of Estimating Season's Repair Yardage

The purpose of preparing an estimate of the season's repair yardage of asphalt pavements is fourfold:

1—To obtain an indisputable basis for requesting funds;

2—To enable the person in charge properly to repair each street and portion thereof without fear of exceeding the total allowance for all streets.

3—To save the contractor from making repeated trips over the same street which, together with the definite, item-

ized quantities, should enable him to make a low bid.

4—To accumulate records to show when any portion of a street should be resurfaced.

The amount of material used in previous years is but one factor to be considered in preparing an estimate. In view of the general tendency to have a different standard for the maintenance of each street, it is evident that guesses made in the office of the amount of material needed for the next year over that used the past year cannot be relied upon. Such procedure is based on the assumption that most of the work done the previous year will have to be torn out and replaced. It does not consider the causes of disintegration or admit that some of them may have been removed by past repairs. If an empirical quantity is added to the total material used the one year, as a factor of safety in asking for material for the next year, it is an admission of ignorance of conditions.

Estimate Made in the Field

To be of any real value the estimate must be made in the field. Two men are necessary, one to drive an automobile and to count and estimate the size of the patches and condition of the street, the other man to pass judgment on the condition of the street and to keep notes. The estimators should have no difficulty in covering 20 miles or 250,000 sq. yds. of pavement per 8-hour day.

What Notes Should Include

The notes should include the size of the existing holes and the size of repair patches required to fill cracks, depressions and disintegrated spots. To the total for each block should be added a percentage between zero and 15 per cent., based upon the following factors:

1—General condition of the surface,

2—Previous rate of disintegration,

3—Age of the surface,

4—Cleanliness as affecting visibility.

To the total yardage computed from the street estimate, as indicated, should be added an allowance for repairs to additional pavement yardage released from guarantee. For the five-year guarantee in Rochester this has been found to average one-tenth of 1 per cent. of the total.

It is expected that considerable estimating must be done before judgment can be relied upon to give proper allowance for the above factors. For this reason and because winter changes must be taken into consideration, a spring inspection is necessary to check up and adjust the estimate made in the fall. The estimator should actually re-estimate enough streets in the spring revision to enable him to fill in the column on the card marked "Revision, pounds, plus or minus," for typical streets as a check on his fall estimate. This assists him in forming better judgment in future estimating. Of course, the budget request must be based on the fall estimate and this cannot be altered by the spring inspection. For this reason a factor of safety of from 5 per cent. to 10 per cent. should be added to the fall estimate. As the estimator becomes more proficient, this factor of safety (or factor of ignorance) need not be added.

It is the general practice for the person in charge of asphalt repairs to keep an extensive diary in the effort to keep the repair yardage within the budget allowance. In addition, it is probable that considerable time of the person in charge, as well as that of clerks, is spent in preparing extensive tables of useless statistics of the work. With the outlined system of estimating, both the diary and the tables are replaced with a set of cards containing the yearly estimating data and a column showing the percentage of the area actually repaired to the total.

It is the Rochester practice to purchase asphalt by the ton, so that it is necessary to multiply the yardage per block by 234, the average number of pounds used to replace an average square yard, in order that useful comparison can be made with the actual quantity used. This requires an additional column on the cards.

The following data are recorded on the card mentioned: The name of the street, and the portion of it under consideration; the total pavement area in square yards; the date when laid, date resurfaced; year of the estimate; then, under fall estimate, the estimated yards, per cent., number of square yards, and number of pounds. There is a column for spring revision in pounds, plus or minus; a column for the number of pounds actually used, and one for the per cent. of the total area. The final column is headed: "Remarks, reasons for variation, condition, etc. The cards measure 5 x 8 ins.

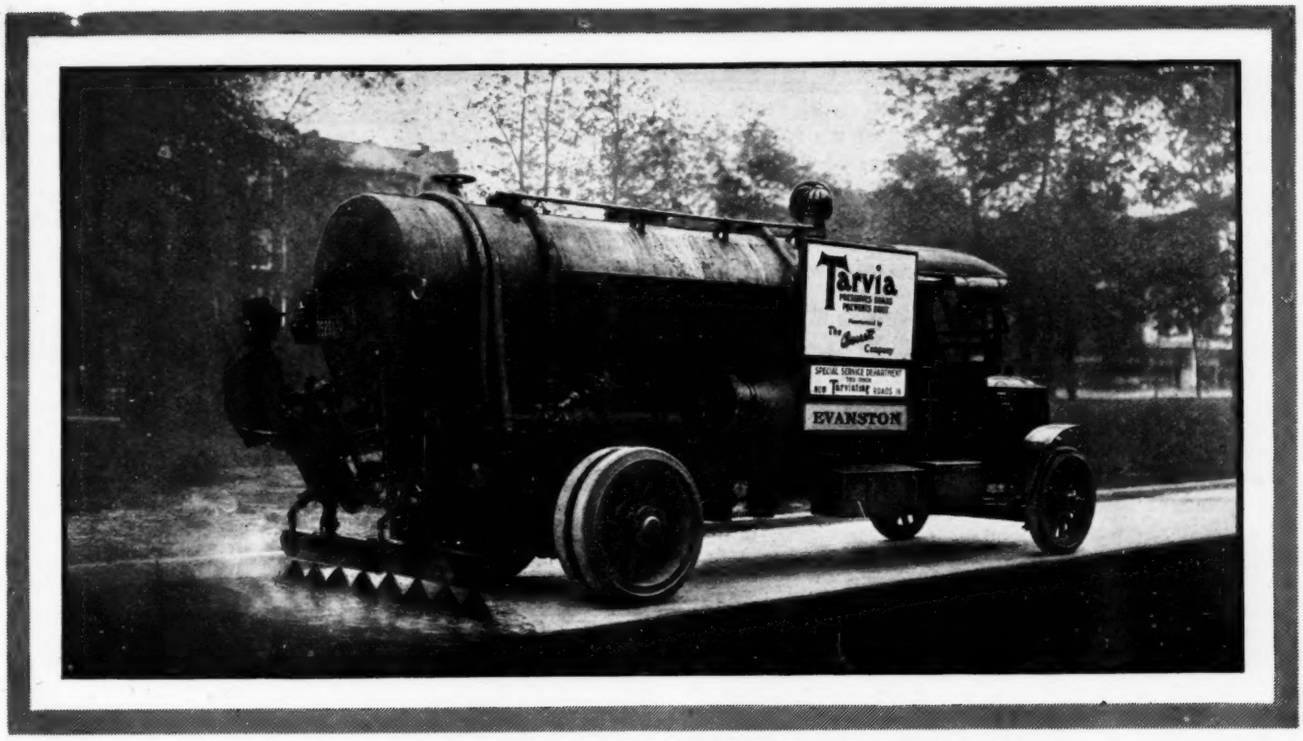
The person in charge of asphalt repairs should route the work so as to be convenient for the contractor. The cards for each day's route should be taken from the office and on them noted the actual repair yardage, together with a note of the reason for discrepancy. These cards then, are in shape for estimate-making the following fall. It will be convenient if these cards are filed according to work routes instead of being in alphabetical order.

The possible objection that the actual repair yardage is likely to be limited to the estimated yardage, regardless of the condition of the street, is not likely if the person in charge considers the problem from the street maintenance viewpoint. Moreover, a record of excesses is available which can be balanced against other streets not requiring the estimated yardage, thereby allowing the person in charge to keep the work in hand or, if conditions warrant it, to give definite reasons for asking an emergency allowance.

Sometimes it is necessary to make a hasty repair trip in the spring to fix the dangerous holes in the main traffic streets. This trip should be confined to repairing dangerous holes in main traffic streets and no time should be wasted with conditions not requiring immediate attention. If this is not done, there will be unnecessary delay in covering all the main traffic streets, and the repair gang will get the habit of making superficial repairs to all streets. Falling into this general practice works havoc with the estimate and necessitates repeated trips to all streets. These are conditions to be avoided.

Combination Lead Melting Furnace and Portable Oil Burner

A practical and economical piece of apparatus for the water works man is the combination lead melting furnace and portable oil burner of Hauck make. Its use is free from smoke and ashes. This device is actually two outfits in one. When used as a melting furnace, 200 lbs. of lead can be melted in 15 minutes and kept in molten condition at cost of few cents per hour. An additional supply of fresh lead melts instantly. When not used for melting lead in the pot, the burner may be detached from the furnace and used for melting lead out of pipe and fitting joints, bending pipes, straightening, preheating in connection with welding, brazing, heating tar and asphalt kettles, etc. The device consists of a furnace on three legs, supplied with a 200 lb. capacity pot. The 12-gal. oil tank is of heavy steel, equipped with pressure gauge, hand pump and fittings. The burner is of the Hauck hand pump type, burning kerosene as fuel. The burner does not consume any air from the tank. The pressure secured by the use of the pump is simply to force the oil to the burner where it is vaporized. A single pumping will operate the apparatus for three hours. The device is made by the Hauck Manufacturing Co.



Auto-tank sprayer equipped with special Tarvia Nozzles, applying hot coating of "Tarvia-A" to road.

Tarvia Service Department helps Road Engineers, Contractors and City Authorities

THE season of 1918 was one of exceptional difficulty, due to war-time conditions, but Tarvia Service was "on the job" every minute.

The following letter from Robert M. Brown, Street Commissioner of Evanston, Illinois, shows that despite all obstacles we were able satisfactorily to take care of his needs, as we did the needs of hundreds of other road authorities all over the country.

Mr. Brown says:

"The efficiency of service by your company in the delivery and application of Tarvia to the City of Evanston during the season of 1918 was remarkable considering the difficulties under which all work of this nature was performed.

"I assure you that your efforts in our behalf are appreciated, as we were able to keep our pavements in good serviceable condition despite the fact that they were subjected to unusually heavy traffic."

The *Tarvia Service Department* offers a mighty helpful service to road engineers, contractors and city authorities. It is manned by highway engineers of long experience, and provided with special apparatus of various kinds for handling Tarvia to the best possible advantage.

In many sections of the country the Tarvia Department can provide automobile-tank service that brings the Tarvia hot from the works or from the tank-cars and delivers it on the job promptly and economically.

In fact, if you want *real co-operation and service* in your road work, call on the Tarvia Department of The Barrett Company. Write, wire or telephone our nearest office and let us know how we can help you. We are ready to serve you.

Tarvia

Preserves Roads—Prevents Dust

The Barrett Company

New York, Cleveland, Birmingham, Seattle, Youngstown, Chicago, Cincinnati, Kansas City, Peoria, Toledo, Philadelphia, Pittsburgh, Minneapolis, Atlanta, Columbus, Duluth, Richmond, Milwaukee, Latrobe, Dallas, Bangor, Bethlehem, Boston, Detroit, Nashville, Washington, Elizabeth, St. Louis, New Orleans, Salt Lake City, Johnstown, Buffalo, Baltimore, Lebanon

THE BARRETT COMPANY, Limited: Montreal, Toronto, Winnipeg, Vancouver, St. John, N.B., Halifax, N.S., Sydney, N.S.

Personal Items

Capt. Lucius A. Fritze, Sanitary Corps, U. S. Army, has become associated with the technical staff of Wallace & Tiernan Co., Inc., New York City, manufacturers of chlorine control apparatus. Capt. Fritze, who was sanitary officer of the Rainbow Division, after the armistice was signed was assigned to the office of the surgeon general in Washington. While there he prepared a history of the sanitary corps of the A. E. F. Capt. Fritze will be the manager of a new office which Wallace & Tiernan Company are opening at Kansas City, Mo., serving territory comprised in the states of Montana, Wyoming, Colorado, North Dakota, South Dakota, Nebraska, Kansas and Missouri.

Beginning August 1, the promotion and inspection bureaus of the Universal Portland Cement Co. were combined under the name of "Service Bureau." J. H. Libberton, formerly "Engineer, Promotion Bureau," and "Inspecting Engineer," located in the general offices of the company at Chicago, became manager of the service bureau; G. E. Warren, assistant manager; J. W. Lowell, eastern manager, Pittsburgh; J. H. Chubb, Northwestern Manager, Minneapolis, and O. L. Moore, chief cement inspector, Chicago. The two bureaus which were combined formerly had separate and distinct duties, the Promotion Bureau handling special service and furnishing of information to cement users and the Inspection Bureau having charge of the physical testing at the mills. In combining the two bureaus, service rendered to cement users by the department will in no way be changed, either in policy or scope of the work.

Arthur H. Blanchard has been appointed Professor of Highway Engineering at the University of Michigan to occupy the chair recently established by the board of regents. He will retain his consulting office at Broadway and 117th street, New York City, until September 15, after which he will be located in Ann Arbor, Michigan.

Captain Bruce Aldrich, who will take charge of the Toronto office of the Asphalt Association as district engineer of the Canadian district, with headquarters at the office of the H. K. McCann Company, Limited, Toronto, Ont., is a native of London, England. He came to Canada at an early age and began his education in the public schools of Ottawa, returning later to England to complete his studies. From England he came to the United States and after serving as a volunteer in the United States Army in the Spanish-American and Philippine wars, he was appointed in 1901 to a position in the office of Inspector of Asphalts and Cements, engineer department, District of Columbia, where he served in various capacities, testing paving materials under Prof. A. W. Dow of New York until February, 1912. In March, 1912, he went to Baltimore, Md., which city was then beginning operations on the biggest paving program it had ever undertaken, with expenditures aggregating nearly $15,000,000. Capt. Aldrich organized and equipped the Municipal Laboratory in which were tested all the materials entering into the new paving. As inspector of asphalts, he supervised the laying of more than 3,000,000 sq. yds. of sheet asphalt and bituminous concrete, having on occasions as many as seven asphalt plants working at the same time. He assisted also in the inspection of the laying of all vitrified brick and granite block paving laid by the city. At the outbreak of hostilities between the United States and Germany, Mr. Aldrich responded to the call of the President and served in France as a captain of infantry for one year, returning to the United States and resuming his former duties in Baltimore June 5, 1919. He resigned this office to become connected with the Asphalt Association of 15 Maiden Lane, New York. Captain Aldrich will devote his attention to cooperation with officials and engineers in the several provinces with a view to bringing about the most constructive results possible in asphaltic highway work.

Proposed Water Filtration and Pumping Plant for Sacramento, Cal.

Charles Gilman Hyde, professor of sanitary engineering at the University of California, has been employed by the City of Sacramento as consulting engineer in the construction of a water filtration and pumping plant for which bonds to the amount of $1,800,000 were voted by the people in June, 1919.

Professor Hyde until recently was in the United States army service, having been commissioned major in the office of the surgeon general at Washington, D. C., and serving in that capacity for more than a year. He has had extensive experience as a water supply engineer. Fifteen years ago he designed the filtration plant at Harrisburg, Pa., and acted as consulting engineer during the period of construction.

The filtration plant at Sacramento is to be of the mechanical or rapid sand type, filtering the water of Sacramento river. Its nominal capacity will be 30,000,000 gals. a day, and sulphate of alumina will be used as the coagulant. This will be the first modern municipal filtration plant in California, and is expected to be in operation early in 1921. Major Hyde is preparing the plans under which contracts will be let.

For more than 50 years Sacramento's water supply has been unfiltered and at times it has been turbid and muddy so it could hardly be used. The decision of the people to build a filtration plant was the result of recommendations made by Prof. Hyde, George H. Wilhelm and Frank C. Miller in 1916, after they had made a diligent and exhaustive investigation of all possible sources of water supply for Sacramento.

Obituary

It is with keen regret that Pawling & Harnischfeger Co announces the passing of Otto A. Ruemelin, works manager and 2nd vice president, on September 1, 1919. As a youth Mr. Ruemelin began his apprenticeship with the Pawling & Harnischfeger Co. After several years as journeyman he was promoted successively to the foremanship of various departments. His energy, ability, and kindly nature made his rise rapid from assistant superintendent to superintendent and finally works manager, which position he has held since 1912. In this capacity he enjoyed a marked respect and comrade-like relation with the men of the shop. His death concludes a period of thirty years association with the Pawling & Harnischfeger Co.

Trade Note

Pressed steel members for beams and studs have now become a well established method of fire-resisting construction. The light weight and simplicity make it particularly desirable in many buildings where the heavier and more involved fireproofing methods would not be practical, particularly in light occupancy buildings such as apartments, stores, schools, hospitals, institutions, hotels, residences, etc. Truscon pressed steel, combined with the hy-rib metal lath, provides a fire resisting construction which is economical in cost. It also assures the additional advantages of light weight, vermin-proofness, and sound-proofness. Truscon pressed steel has been used in very many important buildings with great satisfaction to architects, contractors, and owners. The new catalog on Truscon structural pressed steel, just issued, gives complete information on the use of this construction in building work. In the catalog are details, tables, specifications and numerous illustrations. A copy of this book will be furnished free to interested persons by asking for Structural Pressed Steel Catalog, addressing Truscon Steel Company, Youngstown, Ohio.

WATER WORKS SECTION

Methods Used and Results Obtained in Metering the Water Supply of Terre Haute, Ind.

By Dow R. Gwinn, President and Manager, The Terre Haute Water Works Co., 634 Cherry St., Terre Haute, Ind.

The old notion that water should be as free as the air is not as prevalent as it used to be. Water in the Wabash River is free to all who care to go to the river, dip it up and carry it home. However, we take water from the river through an expensive intake, coagulate it, settle it, filter it, sterilize it and pump it (most of it twice) and deliver it to the consumer in small or large quantities, day or night at a nominal cost—about 6 cts per ton at the highest rate. To be able to do this requires expensive equipment for pumping, purifying, distributing and measuring. An aged colored gentleman was converted at a camp meeting and joined the church. He complained, when he was asked to contribute towards the support of the church, saying that he thought salvation was free. The parson replied promptly, "Salvation is free but some one has got to pay for the pipes."

Historical

The Terre Haute Water Works Company was organized in 1871, and the construction of the plant was started late in 1872. The direct pumping system was adopted.

A wooden enclosure was built underground on the bank of the river, and the water was filtered by passing through the sand and gravel placed on top the timbers. This was abandoned and in 1890 a contract was made with the National Water Purifying Co. for mechanical pressure filters; this was the first public filter plant in the state of Indiana.

The ordinary domestic pressure is 70 lbs.; fire pressure 130 lbs.

Policy of the Company in Metering Services

At first only large consumers such as railroads and industrial plants were metered. Then livery stables, photograph galleries, saloons, hotels and public buildings. Next stores and restaurants. Not much opposition was met until boarding and rooming houses were included. Public indignation meetings were held and oratory flowed freely in denouncing meters and the manager of the company. Space in the newspapers was bought and a series of statements or "Water Talks," as they were headed, were published. Incidentally, when a public utility is attacked, without reason, we believe it pays to buy advertising space and present the facts—a few at a time. The sentence, "It is a good thing to pay for what you get," was used frequently and it was interesting to hear some of our customers using the expression, apparently unconscious that they were using our argument.

In the year 1914, with 44 per cent. of all service pipes metered, including practically every factory and business premises, the average daily consumption was 4,939,617 gals. (82 gals. per capita), but *with a peak load of over 16,000,000 gals.*, during sprinkling hours on hot days. If a serious fire should have occurred it would have been impossible to maintain fire pressure while the peak load was on. Therefore, arrangements were made early in 1916 to set meters on every flat rate service where there was a hose connection.

Explanatory information was prepared and mailed in advance, and the result was only two real protests against the installation of the meters, although there were 3,700 meters set during that year. In 1917 the peak load was less than 10,000,000 gals., a reduction of over 6,000,000 gals.—the average daily consumption being 4,813,765 gals. (74 gals. per capita). During the same time the number of consumers increased from 6,804 in 1914 to 7,492 in 1917.

Incidentally, it pays to inform your customers and take them into your confidence.

The company furnishes the meters and installs them free of charge. The consumer is liable for injury to a meter on his premises, occasioned by the want or lack of ordinary care on his part. In practice the company maintains the meter except when damaged by hot water.

Meters are read monthly, beginning about the 21st of the month. The nearest 100 to the actual reading is used.

Every meter bill bears the following statement: "The company will test meters in the presence of consumers, free of charge." Very few take advantage of the offer; however, it is a good talking point and it shows that the company has confidence in the accuracy of its meters.

There is no allowance for leaks and the readings are conclusive except when the meter is defective or fails to register. In the latter case, the quantity is determined on the basis of consumption when meter was registering.

The company reserves the right to meter any service and any consumer may demand a meter, but cannot change again to flat rate service.

While indignation meetings were held when meters were put on boarding and rooming houses, it is safe to say, that citizens of Terre Haute now approve of the meter system and that there would be serious objections to a suggestion that the old flat rate basis be restored.

Pumpage Results Obtained by Metering

The reduction of the peak load from over 16,000,000 to less than 10,000,000 gals., has been referred to. This was the result of metering every service where there was a hose connection. The average daily consumption was not materially affected at that time for the reason that practically all premises except private residences had been metered previously and owing to heavy demand for water by industrial consumers.

In 1900 with 8 per cent. of all services metered the pumpage was 1,564 gals. per consumer, while in 1918 with 95 per cent. metered, the pumpage was 646 gals. per consumer. During this period the per capita consumption was reduced from 90 to 74 gals., and the consumers per thousand population was increased from 58 to 114—or 17 persons per live service in 1900 and 8.7 in 1918. The comparatively small number of consumers is due to the ease with which water may be secured from the ground; it might be said that this means a strong competitive condition.

Quantities Used by Consumers

In respect to gallons per consumer, there is one that used approximately 900,000 gals. per day throughout the year 1918 and three others used a total of 600,000 gals. per day, making a total of 1,500,000 gals. by four consumers.

Under the system of accounting required by the Public Service Commission, practically all consumers except railroads, factories, public parks and street sprinkling wagons are classified as, "Commercial." The latter class in Terre Haute—7102 in number—comprise over 99 per cent. of the total number

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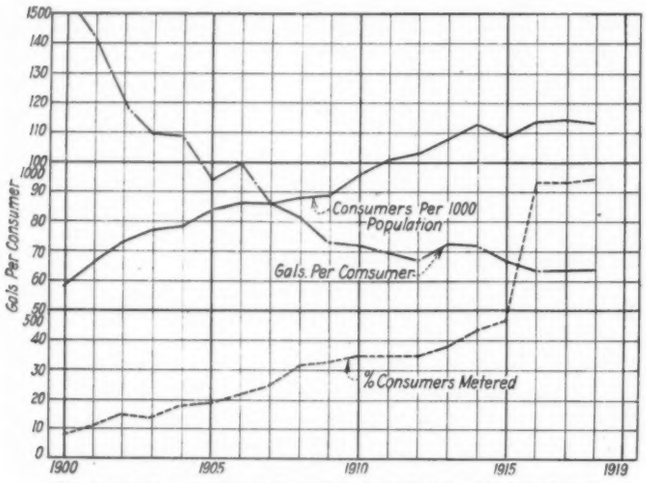
of metered consumers. The approximate average monthly consumption by the metered commercial class in the year 1918 and the number of consumers using certain quantities per month was as follows:

Using less than 750 gals. per month.....	553	% of all	7.8
Using 750 gals. per month.....	898	% of all	12.6
Using 1,500 gals. per month.....	933	% of all	13.1
Using 2,250 gals. per month.....	1,060	% of all	14.9
Using 3,000 gals. per month.....	1,061	% of all	14.9
Using 3,750 gals. per month.....	702	% of all	9.9
Using 4,500 gals. per month.....	477	% of all	6.8
Using 5,250 gals. per month.....	320	% of all	4.5
Using 6,000 gals. per month.....	226	% of all	3.2
Using from 6,750 to 9,750 gals. per month...	492	% of all	6.9
Using from 10,500 to 19,500 gals. per month...	239	% of all	3.4
Using 20,250 gals. and over per month.....	141	% of all	2.0

As 3,000 gals. are allowed for the minimum rate, there was an average of 4,505 consumers per month or 63.3 per cent. of all that did not pay over 75c per month.

The average amount of each bill for the year 1918 for the commercial class of consumers based on rates of 25c per thousand for the first 20,000 gals. used in a month and 20c per thousand for the next 80,000 gals. in the same month was $1.25. The schedule provides lower rates for larger quantities, the lowest rate was 5c per 1,000 gals., which has since been



DIAGRAMS SHOWING THE NUMBER OF CONSUMERS PER 1,000 POPULATION, THE PER CAPITA CONSUMPTION, AND THE PERCENTAGE OF CONSUMERS METERED, TERRE HAUTE, IND., WATER WORKS 1900 TO 1918

increased to 5¾c. For all metered consumers, including industrial, etc., the average monthly bill was $1.74. Of all metered consumers, including industrial, etc., only 2.3 per cent. used on an average more than 20,000 gals. per month.

Comparison of Revenue on Meter Basis with Flat Rates

In 1913 the annual flat rates were $5 for domestic use, 6 rooms or less; $1 for each additional room. Additional, for bath $3, closet $3; $5 for 30 ft. sprinkling and 5c per foot for additional frontage—corner lots measured the long way.

The minimum meter rate was then $12 per year and the rate for the first 20,000 gals. per month was 30c per thousand. In that year we were supplying 819 residences, boarding, rooming and apartment houses through meters.

On flat rates the average monthly payments would have been $1.86. The average monthly on the meter basis was $1.34—a reduction of 52c per month, or $6.24 per year, or 23 per cent. For a period of five years the reduction of revenue from this class of consumers on account of changing to the meter basis, was approximately 25 per cent. In view of the many leaks and abuses that were stopped there were not regrets on the part of the water company.

The average daily consumption for the 819 consumers in 1913 was 150 gals.

There are two large educational institutions in Terre Haute; hence there are a number of rooming and boarding houses.

In the first three months of 1918 the minimum monthly rate for small meters was 60c, and the last nine months it was 75c. Our records show that a certain lot of 98 residence consumers with bath rooms and host connections paid an average of 97c per month in 1918; this was 65c or 40 per cent. less than the service would have cost on the flat rate basis. If the minimum rate had been 75c per month for the entire year (rate 25c per 1,000 gals.) the average per month would have been $1.01—a reduction of 38 per cent from what would have been paid on the flat rate basis.

Meters and Installations

About 98 per cent. of all meters are of the Empire type. The writer began using these meters in 1886, and is still buying them because they give good service for a long period and are easy to repair. For private fire protection services, we use the Hersey Detector and the Trident Protectus.

Basement Installation

Where meters are set in basements or cellars, they are located below the floor level at the point where the service enters the cellar. Our rules provide that service pipes shall be laid at a depth of not less than 4½ ft. underground and must be laid under foundations and a depth of at least 1 ft. maintained below floors of cellars. An excavation 20 x 26 ins.,

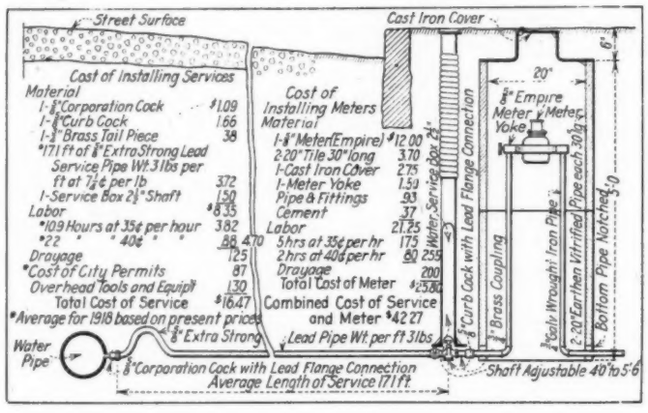

Street Surface
Cast Iron Cover
Cost of Installing Services
Material
1-¾" Corporation Cock $1.09
1-¾" Curb Cock 1.66
1-¾" Brass Tail Piece .38
*171 ft of ¾" Extra Strong Lead Service Pipe Wt 3.1 lbs per ft at 7¼¢ per lb 3.72
1-Service Box 2½" Shaft 1.50
Labor $8.35
*10.9 Hours at 35¢ per hour 3.82
*2.2 " " 40¢ " .88 4.70
Drayage 1.25
*Cost of City Permits .87
Overhead Tools and Equipt 1.30
Total Cost of Service $16.47
*Average for 1918 based on present prices
Cost of Installing Meters
Material
1-¾" Meter (Empire) $12.00
2-20" Tile 30" long 3.70
1-Cast Iron Cover 2.75
1-Meter Yoke 1.50
Pipe & Fittings .93
Cement .37
Labor 21.25
5 hrs at 35¢ per hr 1.75
2 hrs at 40¢ per hr .80 2.55
Drayage 2.00
Total Cost of Meter $25.80
Combined Cost of Service and Meter $42.27
Lead Pipe Wt per ft 3 lbs
¾" Extra Strong
Water Pipe
¾" Corporation Cock with Lead Flange Connection
Average Length of Service 171 ft
Meter Service Box 2½"
¾" Curb Cock with Lead Flange Connection
¾" Brass Coupling
¾" Galv Wrought Iron Pipe
20"
¾" Empire Meter
Meter Yoke
6"
2-20" Earthen Vitrified Pipe each 30" long
Bottom Pipe Notched
3'-0"
Shaft Adjustable 40" to 5'-6"

DIAGRAM OF SERVICE AND METER INSTALLATIONS, THE TERRE HAUTE WATER WORKS CO., SHOWING WHAT THE COMPANY MUST DO FOR A NEW CUSTOMER WHERE THERE ARE NO CONNECTIONS.

lined with brick or concrete, is made for meters set in cellars. Either an iron cover or one made of 2 in. boards are used. After the meter is set, saw dust or old newspapers may be used, if thought necessary, to prevent freezing. About 2,000 meters are installed in basements.

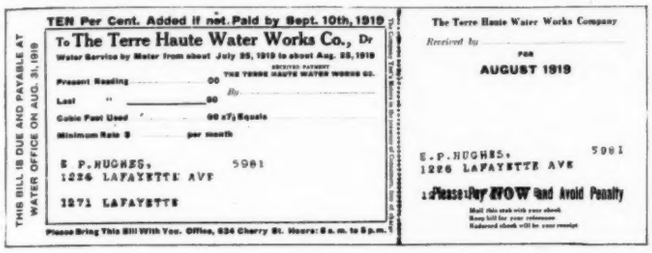
Outdoor Installation

At first, brick pits, 2 ft. 8 ins. inside diameter at bottom, by 4 ft. 6 ins. deep, were built for outdoor installations. These were provided with iron frames and covers, made locally, with an opening of 19 ins. There are 317 installations of this character and the records do not show that a meter was ever frozen in one of them, even with a temperature of 18 degrees below zero.

Later, in order to reduce cost of construction and labor in reading, brick pits were made 3 ft. 3 ins. deep by 2 ft. 8 ins. in diameter at bottom, with same kind of covers used on the 4 ft. 6 ins. pits. Risers were used to raise the bottom of the meter to a level of 3 ft. 3 ins. below surface and the excavation filled to that point. There are about 750 installations of this design.

The next plan of installation was a concrete tile, 15 ins. in diameter by 3 ft. 6 ins. long, with a Wabash cover, 9 ins. in height, an 8 in. throat opening and an extra lid. This made a total depth of 4 ft. 3 ins. Ford yokes were used on risers so that the top of meters would be approximately 13 ins. below the surface of the ground or top of cover. There are near-

ly 4,000 of these installations, some having clay instead of concrete tile. The writer confesses to an error in judgment in selecting a tile 15 ins. in diameter. Experience has shown that with sandy soil, such as largely prevails in Terre Haute, that the tile should have been 20 ins. in diameter and about


TEN Per Cent. Added if not Paid by Sept. 10th, 1919

To The Terre Haute Water Works Co., Dr

Water Service by Meter from about July 25, 1919 to about Aug. 25, 1919

Present Reading 00

Last " 00

Cubic Feet Used ..... 00 x7½ Equals

Minimum Rate $ ..... per month

E. P. HUGHES, 5981
1226 LAFAYETTE AVE

1271 LAFAYETTE

Please Bring This Bill With You. Office, 634 Cherry St. Hours: 8 a. m. to 5 p.m.

THIS BILL IS DUE AND PAYABLE AT WATER OFFICE ON AUG. 31, 1919

The Terre Haute Water Works Company

Received by .....

FOR

AUGUST 1919

E. P. HUGHES, 5981
1226 LAFAYETTE AVE

Please Pay NOW and Avoid Penalty

Mail this stub with your check
Keep bill for your reference
Indorsed check will be your receipt

FORM OF WATER BILL USED BY THE TERRE HAUTE WATER WORKS CO.

5 ft. in depth; that vitrified tile or clay sewer pipe would probably have been a better non-conductor of cold.

At present we are installing meters out doors in 20 in. vitrified sewer pipe, using two pipes, each 2 ft. 6 ins. in length, the lower one being slotted to accommodate old service pipes that may not be as deep as we now are laying them. We use the Clark Meter Box Cover and Coupling Yoke; as these covers are 6 ins. high, the total depth of the installation is 5 ft. 6 ins.

Frozen Meters

Frost has been known to penetrate to a depth of 4 ft. 7 ins. in the sandy soil of Terre Haute. In a nearby city, with the same temperature but with clay soil, the frost does not penetrate to a depth of 3 ft.

In the winter of 1917-1918 there were 17 days when the U. S. weather office in Terre Haute reported zero and below zero weather, with a minimum of 18 degrees below zero. Out of 7,064 meters there were 616 frozen or 8.7 per cent. of all; these were divided as follows:

In brick pits, 3 ft. 3 ins. deep,	16.2%	of installations.
In 15 in. concrete and clay tile,	11.2%	of installations.
In 18 in. concrete tile,	4.5%	of installations.
In basements or cellars	2.6%	of installations.
In brick pits, 4 ft. 6 ins. deep,	0%	of installations.

These meters were repaired without cost to the consumer. In most cases the frozen basement meters were the result of leaving windows open.

Outdoor Meter Boxes Without Locks

About one thousand brick pits were provided with an iron frame and cover having a 19 in. opening. Originally these were not provided with locks. However, complaints were received from four persons, claiming that they had been injured by stepping on loose lids which turned. Two suits were filed for a total of $12,000, which were settled at a cost of $1,000. After this, all meter box covers of the design without locks were provided with them. Complaint has been made by a few consumers that they cannot get to the meters to read them. In reply, we offered to open the meter box, but have only found a few who actually wanted to read the meter.

Meter Readings

Meters are read monthly, beginning about the 20th or 21st of each month, so that bills may be ready for delivery by the last day of the month when they are due. Ordinarily there are ten to twelve readers, most of them being men who are regularly employed in various capacities. We usually have three or four high school boys reading on Saturdays and pay them 35c per hour.

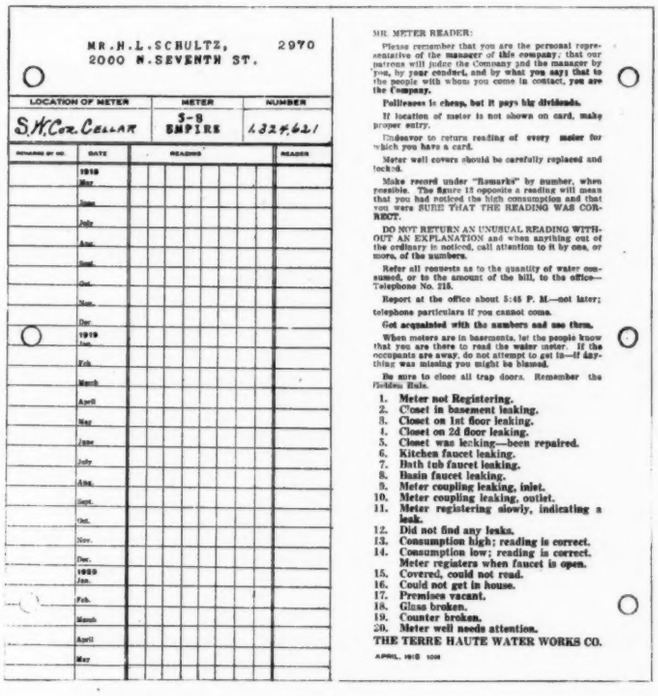
The readings are recorded on heavy linen paper instead of cards so that about 200 can be placed in a loose leaf binder. In preparing a new lot at the expiration of the old ones, the records are run through on the Addressograph for the name, street number and ledger number. We find that readings are expedited by giving the general location of meters.

There are 37 routes, two being taken by men on bicycles. Portable blackboards, 31 x 42 ins., are provided on which are painted headings and lines with numbers corresponding to the numbers of the meter books. The headings are, "Reader, Time out, Time in." The reader writes his name and time out opposite the number of the book he takes, which must be the one next above the last one recorded. The readers are not allowed to select particular books or routes. The average number of readings per hour ranges from 30 in April to 22 in June. The best individual record made was an average of 49 per hour in the month of April, the lowest in the same month was 22.

The cost of reading meters is materially increased on account of going back over the routes to read meters that could not be read on the first trip due to inability to get into basements. Extra readings are also taken where there is reason to believe that errors have been made. The average monthly cost of reading meters, including extra readings for the year ending June 30, 1919, was $184.60, which divided by 7,462, the number of meters, gives an average cost of 2½ cts. per meter.

We have a stamped postal card with printed request that the occupant read the meter and mail; these are left where the house is locked and there are indications that someone is home in the evenings.

Where it is necessary to send back for a reading or to


MR. H. L. SCHULTZ, 2970
2000 N. SEVENTH ST.

LOCATION OF METER	METER	NUMBER
S.W. Cor. Cellar	5-9 EMPIRE	4327621

READING BY NO.	DATE	READING	READER
	1919 May		
	June		
	July		
	Aug.		
	Sept.		
	Oct.		
	Nov.		
	Dec.		
	1919 Jan.		
	Feb.		
	March		
	April		
	May		
	June		
	July		
	Aug.		
	Sept.		
	Oct.		
	Nov.		
	Dec.		
	1920 Jan.		
	Feb.		
	March		
	April		
	May		

MR. METER READER:

Please remember that you are the personal representative of the manager of this company; that our patrons will judge the Company and the manager by you, by your conduct, and by what you say; that to the people with whom you come in contact, you are the Company.

Politeness is cheap, but it pays big dividends.

If location of meter is not shown on card, make proper entry.

Endeavor to return reading of every meter for which you have a card.

Meter well covers should be carefully replaced and locked.

Make record under "Remarks" by number, when possible. The figure 12 opposite a reading will mean that you had noticed the high consumption and that you were SURE THAT THE READING WAS CORRECT.

DO NOT RETURN AN UNUSUAL READING WITHOUT AN EXPLANATION and when anything out of the ordinary is noticed, call attention to it by one, or more, of the numbers.

Refer all requests as to the quantity of water consumed, or to the amount of the bill, to the office—Telephone No. 215.

Report at the office about 5:45 P. M.—not later; telephone particulars if you cannot come.

Get acquainted with the numbers and use them.

When meters are in basements, let the people know that you are there to read the water meter. If the occupants are away, do not attempt to get in—if anything was missing you might be blamed.

Be sure to close all trap doors. Remember the Golden Rule.

1. Meter not Registering.
2. Closet in basement leaking.
3. Closet on 1st floor leaking.
4. Closet on 2d floor leaking.
5. Closet was leaking—been repaired.
6. Kitchen faucet leaking.
7. Bath tub faucet leaking.
8. Basin faucet leaking.
9. Meter coupling leaking, inlet.
10. Meter coupling leaking, outlet.
11. Meter registering slowly, indicating a leak.
12. Did not find any leaks.
13. Consumption high; reading is correct.
14. Consumption low; reading is correct. Meter registers when faucet is open.
15. Covered, could not read.
16. Could not get in house.
17. Premises vacant.
18. Glass broken.
19. Counter broken.
20. Meter well needs attention.

THE TERRE HAUTE WATER WORKS CO.

APRIL, 1919 1000

FRONT AND REAR VIEWS OF LOOSE-LEAF IN METER READER'S BOOK, TERRE HAUTE WATER WORKS CO., TERRE HAUTE IND.

verify the reading on the regular route, the permanent reading card is not taken, but a small card is furnished the reader. This is done to avoid danger of loss of the record.

Entering Readings in Ledger and Billing

Loose leaf ledgers are used and are arranged in order on the different streets, beginning with the river or lowest numbered streets, then the diagonal and then those that are at right angles with the numbered streets.

The meter reading routes follow as closely as possible the arrangement of accounts in the ledgers. In the front of each reading book a monthly record is kept of the clerk who enters the readings. Each clerk is provided with a table showing each 100 cu. ft., equivalent in gallons and amount or charge at schedule rates. These tables are typewritten, every tenth

line is in red ink; the size of the table is 10 x 15 ins., and gives each 100 cu. ft. up to 32,000 or 240,000 gals.

After the readings and charges are entered in the ledger, a second clerk copies the readings, and the cubic feet consumed on the bills which are addressed previously on the Addressograph. A third clerk stamps the gallons and amount due. Rubber stamps are provided for each 100 cu. ft., and are so marked on top; on the face or printed portion is shown the gallons that are equivalent, and the amount due. They are arranged in a special case so that the work proceeds rapidly. Later the bills are compared with the ledger to detect errors and omissions.

number are only paying one-half as much as on the flat rate basis.

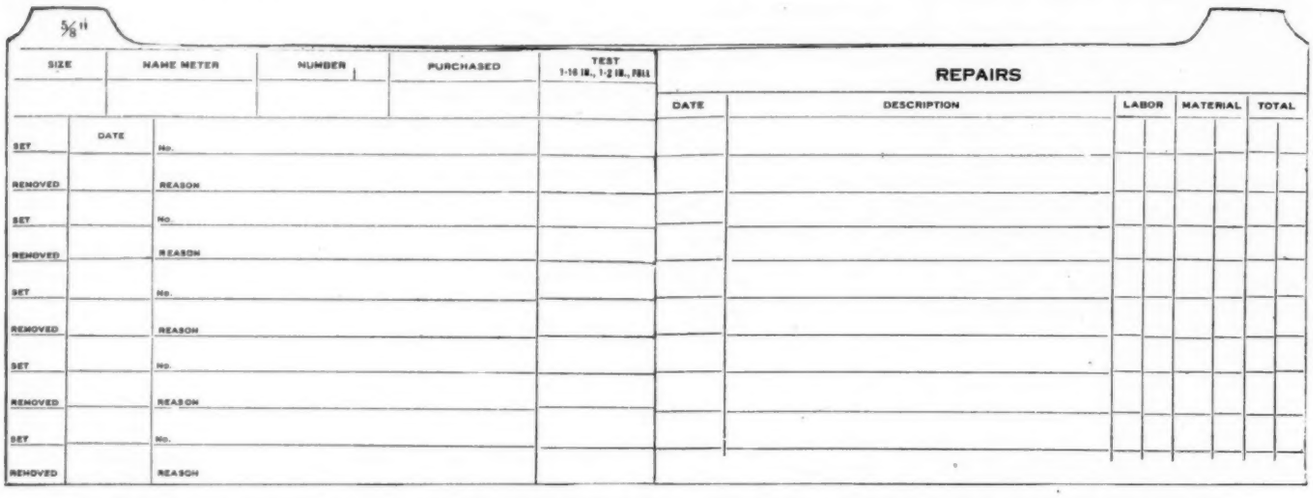
The consumption of water has been reduced by reason of more care being taken of plumbing fixtures and by the elimination of gross sprinkling abuses.

The peak load has been reduced 40 per cent.

We expect to be able, ere long, to report that the percentage of metered services has been increased from 95 per cent. to at least 99 per cent.

Miscellaneous Data

The following miscellaneous data are appended, as they may be of interest to some water works men.



FRONT AND REAR VIEWS OF METER HISTORY CARD USED BY THE TERRE HAUTE WATER WORKS CO., TERRE HAUTE, IND.

With the exception of about 200, all bills are delivered direct to the consumer.

Delivering Bills

Bills are delivered on the last day of the month. In addition to some of our regular employes, about 15 to 18 extra helpers are used; these are mostly women and girls and are paid $3 for about 8 hours' work. They are required to furnish references and are also expected to read our instructions each morning before starting work, although they may have read them a half dozen times previously. The routes are ready, so there is little time lost before beginning work. Three dollars in change is furnished, a large pocketbook for currency and detached coupons; also two street car tickets. They are responsible for the money they collect. Very few balance short beyond a few cents. As soon as they reach the office the coupons are delivered to a clerk who lists them on the adding machine while the money is being counted. We have yet to find a dishonest person among those who deliver and collect our bills. It is a great convenience to our customers to be able to pay without making a trip to the office. About 40 per cent. of the bills are paid on delivery.

The average number of coupons brought in on a certain day was 87—the total number being 2,270. Of the 35 routes, about 25 are delivered on the last day of the month, the balance on the following day. The average monthly cost of delivering bills by hand for six months ending June 30, 1919, was $126.91. The average cost per bill was 1.76 cts.; this includes the cost of collecting the 40 per cent. of bills that were taken out. The cost of mailing is 2 cts. for postage alone.

There is a delayed payment charge of 10 per cent. when bills are not paid within 10 days after they are due. About 93 to 94 per cent. of all consumers pay their bills by the 10th of the month. The additional 10 per cent. is collected in all cases.

Conclusion

The metering of residences and stores in Terre Haute has resulted in a reduction in cost of water to the consumer. A

The following table shows the quantity and cost of coal and alum bought in recent years by the Terre Haute Water Works Company:

COAL

Year	Tons	Average Cost per Ton	Total Cost
1915	4,048.75	$1.00	$4,048.75
1916	3,905.85	1.18	4,639.69
1917	3,812.16	1.92	7,337.74
1918	4,620.40	2.64	12,215.61

Present cost of coal f. o. b. cars Terre Haute, Ind., $2.77 per ton.

ALUM

Year	Wt. in Lbs.	Average Cost per 100 Lbs.	Total Cost
1915	497,000	$0.85	$4,162.59
1916	545,400	1.21	6,593.51
1917	631,343	1.18	7,467.99
1918	635,780	1.587	10,094.37

Cost of alum December, 1918, $2.01—Cost in February, 1919, $1.894.

The following table, compiled in December, 1918, shows the prices of coal, alum and other supplies used in the operation and maintenance of the Terre Haute water works. The prices are taken from the records of the company under dates as shown:

Item	Unit	1914-1917 Mo.	Yr.	Price	1918 Mo.	Price	% Increase
Coal	Ton		1914	$1.00	Dec.	$2.77	177
Sulphate of Alumina	100 lbs.		1914	.84	Dec.	2.014	140
Hypochlorite of Lime	100 lbs.		1914	1.30	Oct.	4.00	207
Neutrient, Gelatine and Agar	Liter		1914	3.40	Dec.	4.50	32
Coal Oil	Gal.	Apr.,	1916	.08	Dec.	.125	56
Gasoline	Gal.	Aug.,	1915	.10	Dec.	.23	130
Havoline Oil	Gal.	Oct.,	1916	.30	July	.43	43
Cylinder Oil	Gal.	May,	1914	.57	Nov.	.695	22
Engine Oil	Gal.	Aug.,	1915	.143	Dec.	.286	100
White Cotton Waste	lb.	Jan.,	1915	.085	Oct.	.188	121
Square Flax Packing	lb.	May,	1916	.26	July	.37	42
Paint and White Lead	lb.	May,	1914	.07	Oct.	.13	85
Brooms	Doz.	July,	1916	5.50	July	12.00	118
Transmission Rope	lb.	Apr.,	1913	.18	Aug.	.37	105
Stirling 3¼ in. Boiler Tubes	Each	Apr.,	1916	4.35	Apr.	7.25	66
⅝ in. Meter Repairs (average)	Each		1915	.557	Dec.	.743	33
Auto Casing, K. S. 30x3½ in.	Each	May,	1916	17.01	Oct.	28.18	65
Applications	M	Feb.,	1916	22.75	Sept.	47.08	106
Meter Bills	M	Mar.,	1915	1.43	June	2.05	43
Envelopes 6¾ in. Outlook	M	Feb.,	1914	1.53	Dec.	2.71	77

Paved Street Repairs Permits .....Yard	1914	2.50	Dec.	5.00	100
Ledger Sheets .....M	Aug., 1916	15.00	Dec.	19.00	26
Paper Towels .....Case (25)	Mar., 1915	4.50	Apr.	8.00	77
Machinist Labor .....Hour	1914	.60	Dec.	1.25	108
Boilermakers' Labor .....Hour	May, 1914	.60	Sept.	1.00	66
Compensation Insurance Rate per $100 of Pay Roll—					
Pumping Station Employes...	Sept., 1915	.72	Oct.	1.56	116
Laborers, Trench Diggers, etc.	Sept., 1915	2.50	Oct.	4.69	87
Foremen, Inspectors, Meter Readers	Sept., 1915	1.00	Oct.	2.00	100
Clerks and Officials	Sept., 1915	.06	Oct.	.10	66
Average Increase 86.7					86.7

The Ipswich River Water Supply for the City of Lynn, Mass.

By H. K. Barrows, Consulting Engineer, 6 Beacon St., Boston, Mass.

General Statement

The development of the water supply of the City of Lynn, Mass., is typical of that of many Massachusetts cities where rapid growth of population and industries has required frequent additions to the supply system. In the earlier years cities have in many cases failed to appreciate the need to look well ahead, with the result that water supply additions have been more or less makeshifts, soon outgrown.

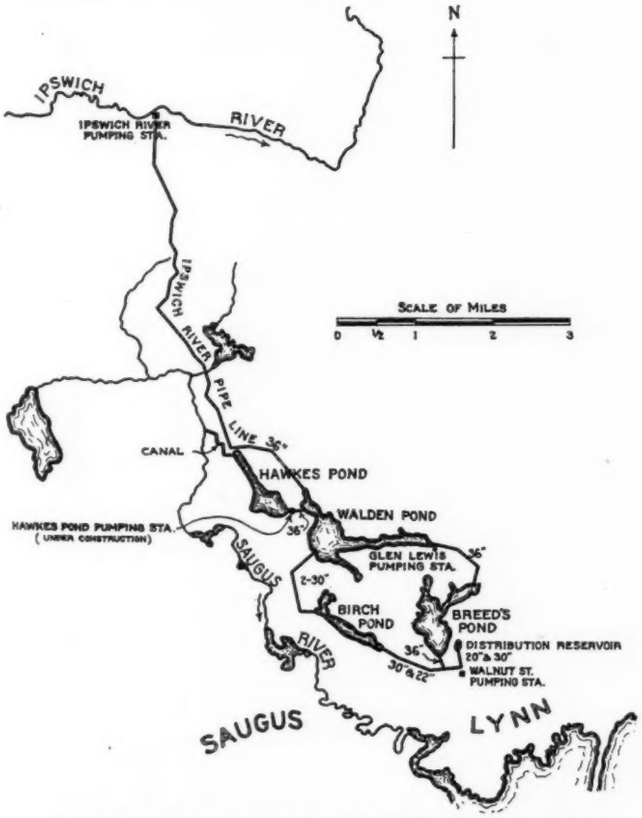


FIG. 1. MAP OF THE WATER SUPPLY SYSTEM OF LYNN, MASS.

In later years, however, often under the direction of the State Board of Health, broader plans have been more generally adopted, with the idea of settling the water supply problem for a substantial period of time.

The additional water supply of the City of Lynn from the Ipswich River, granted under legislative right in 1901, but with the necessary works only recently completed, will for many years provide for the city's needs.

It is the purpose of this article to describe briefly the essential features of these new supply works and some of the steps taken in planning them.

Old Supply System

The original water supply (1870) was from Breeds Pond, (see Fig. 1), of small capacity and yield and within the city limits and serving but for a few years. Water was pumped to a distribution reservoir of 20 mill. gals. capacity which is still in use.

Extensions of the supply system to include Birch Pond, a canal to the Saugus River, Walden and Hawkes Pond (all not far from the city), as well as construction to increase storage capacity in Breeds and Walden Ponds, were made at various times up to 1904.

Between 1912 and 1915 a new dam at Breeds Pond was built, affording a large increase in storage capacity, as by that time the general method of obtaining the future water supply of the city had been determined. This consists of utilizing as far as possible the natural yield of the various ponds previously noted, supplementing this as required by water from the Ipswich River. Large storage capacity (principally in Walden and Breeds Ponds) is provided to improve the quality of the water.

For some time water can also be obtained from the Saugus River (by canal to Hawkes Pond), but this cannot be premanently included in the supply owing to the steadily increasing degree of pollution of this stream.

The capacity and safe yield, etc., of these various ponds are given in the following table:

CITY OF LYNN—CAPACITY AND YIELD OF RESERVOIR SYSTEM

Pond	Area of Pond at H. W. Level Acres	Max. Draft Feet	Storage Capacity Mill. Gals.	Total Drainage Area Sq. Miles	Estimated Safe Yield Mill. Gals. Per Day
Breeds	210	55	1,600	1.07	0.70
Walden	240	40	2,000	1.75	1.75
Hawkes	75	26	330	1.86	1.30
Birch	82	20	400	0.68	0.68
Total	607		4,330	5.36	5.3

The safe yield of this reservoir system by itself is thus about 5 mill. gals. per day (based on Sudbury River yield but with correction for relative water areas).

Water Required from the Ipswich River

The estimated future water consumption of the city (which also includes the adjacent Town of Saugus) used in these studies and the corresponding deficit in yield of the reservoir system, or amount to be provided from the Ipswich River in a very dry year, was as follows:

Year	Estimated Daily Consumption Mill. Gals.	Water from Ipswich River Mill. Gals. P. D.
1915.....	7.5	2.5
1925.....	11	6
1935.....	15	10
1945.....	20	15

Yield of Ipswich River

The Ipswich River at South Middleton (the diversion point according to the Act of 1901) has a drainage area of about 44 sq. miles, is of slight fall, with a small percentage of water area, but considerable swamp and meadow areas which overflow at times. Mean annual rainfall is about 41 ins.

Measurements of flow at two points on the river had been made by the State Board of Health for short periods prior to 1913, but of sufficient extent in time to conclude after comparison that the Sudbury River records (available since 1874) could properly be used as a yield basis, making due allowance for relative water areas on the two basins.

Water to be Pumped from Ipswich River

The legislative act limited the time of pumping during each year to the months of December to May, inclusive, and also required a minimum of 10 mill. gals. per day to be let down the river. Keeping this in mind, the amount of water to be pumped from the Ipswich River and the time of pumping in any year would depend: (1) on the yield of the reservoir system as previously noted, and, (2) the distribution of the yield of the Ipswich River during the six months when pumping

could be carried on, considering also desirable limits in maximum capacity of pump equipment.

Three parallel sets of computations were then made by the hydrograph method covering the period 1875-1912, inclusive, on the basis of an average daily consumption of 10, 15 and 20 mill. gals. respectively, further assuming the maximum pump capacity at 20, 40 and 60 mill. gals. per day respectively. The results of these computations gave, for the various different assumed rates of consumption: (1) the amount of pumping required during any month of this period of 38 years, (2) the

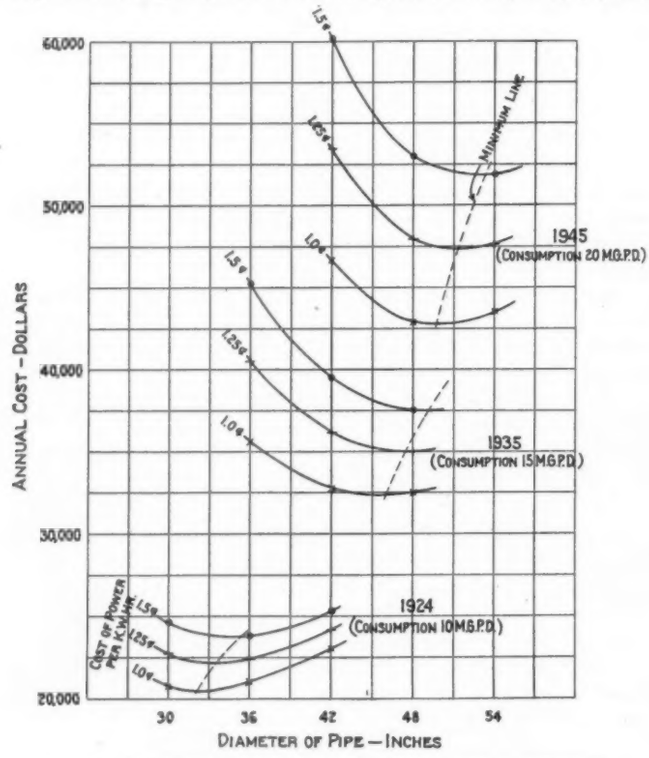


FIG. 2. DIAGRAM FOR DETERMINING THE ECONOMICAL SIZE OF THE IPSWICH RIVER PIPE LINE.

reservoir capacity necessary for each year, and ,(3) the amount drawn from storage each month. Following is a tabular summuary of results:

PUMPING REQUIRED FROM IPSWICH RIVER AND NECESSARY STORAGE CAPACITY AT VARIOUS FUTURE DATES

Item	Rate of Consumption—Million Gallons per Day (and approximate date of this consumption) 10 (1924)	15 (1935)	20 (1945)
Rate of pumping mill. gals. per day—			
Average	11.4	22.5	32.4
Maximum	20.0	40.0	60.0
Minimum	4.1	5.0	5.0
Number of months of pumping—			
Average	5.1	5.4	5.6
Maximum	6.0	6.0	6.0
Minimum	3.8	4.4	4.8
Reservoir Capacity required, mill. gals.—			
Average	1,660	2,650	3,690
Maximum	2,160	3,760	6,060
Minimum	906	1,800	2,710

Obviously storage capacity in the two principal reservoirs (Breeds and Walden Ponds), which totals nearly 4,000 mil. gals., is adequate for a considerable period of years even with a liberal allowance of time of holding stored water to insure good quality.

Size of Pipe Line to Ipswich River

Studies were next made to ascertain the most economical size of pipe in 1924, 1935 and 1945, when the consumption is estimated at 10, 15 and 20 mill. gals. per day respectively. Curves of total annual cost of pipe line and pumping were plotted from the results of the computations as shown on Fig. 2, omitting certain items of cost, such as right-of-way, pumping station, engineering, etc., common, or substantially so, in all cases.

Cast iron pipe at $25 per net ton was assumed because at the time of these studies (1913) it was without question the most economical material for use. The pipe as actually purchased later in the year cost in the vicinity of $21 per ton.

To allow for possible variation in cost of power for pumping, curves for 1.0c, 1.25c and 1.5c per k.w.hr. were plotted in each case.

From Fig. 2 it will be seen that the best size of pipe was about as follows:

Year	Size of Pipe
1924	36 ins. or less
1935	48 ins.
1945	54 ins. or less

In acordance with these results the capitalized cost of two schemes was computed:

(1) A 36-in. pipe to be laid at first, followed by another about 1930. (Two 36-in. pipes would substantially afford a capacity equal to one 48-in. pipe.)

(2) A 48-in. pipe to be laid at first and adequate until about 1940.

These costs were $248,000 and $335,000 respectively (assuming a life of 50 years for the pipe), indicating the advisability of the 36-in. pipe as the first installation. This size was adopted and the line constructed (see Fig. 1) during 1914 and 1915.

Cost of Pipe Line

This work was all done directly by the employees of the Water Department. Approximate costs were as follows: (length about 30,000 ft.).

COST OF IPSWICH RIVER PIPE LINE (36 in. c. i.)

Item	Total Cost	Cost per Lin. Ft.	Remarks
Labor	$65,660	$2.19	Laborers at $2.50 per day.
Pipe and Valves	105,000	3.50	5,782 tons pipe 38 tons specials 4 24-in. gates 11 8-in. gates
Lead	9,140	0.30	About 4.5c per lb.
Yarn	490	0.01	7.25c per lb.
Hauling Pipe	10,630	0.35	Hauled with motor truck. Does not include labor, but full cost of truck.
Miscellaneous	9,640	0.32	
Total	$200,560	$6.67	

Ipswich River Pumping Station

Equipment. Considerable study was given as to the type of pumping equipment to install, with the result that motor-operated units were found to be most economical and desirable—all things considered. In accordance with bids received Nov. 16, 1915, a 15-mill. gal. per day 18-in. De Laval pump, direct connected with a 250-h.p. G. E. motor @ 875 R. P. M. (3 phase, 60 cycle, 4,000 volts) was installed, at a cost of about $12,780, including station equipment and piping, revolving screen, etc.

Pumping Station. This was built by contract during 1915-16. The substructure and intake to the river, of reinforced concrete, cost about $13,300. The superstructure was of brick (yellow salt glazed inside and rough tapestry outside), with wooden roof beams and metal ceiling, about 48x25 ft., with space for a second pumping unit. Cost about $5,200.

The appearance and general arrangement of the station and equipment are shown in Figs. 3 and 4.

Transmission Line

Power for operating this station is furnished by the Lynn Gas & Electric Co., who also built the transmission line (during 1916-17) paid for by the City as follows:

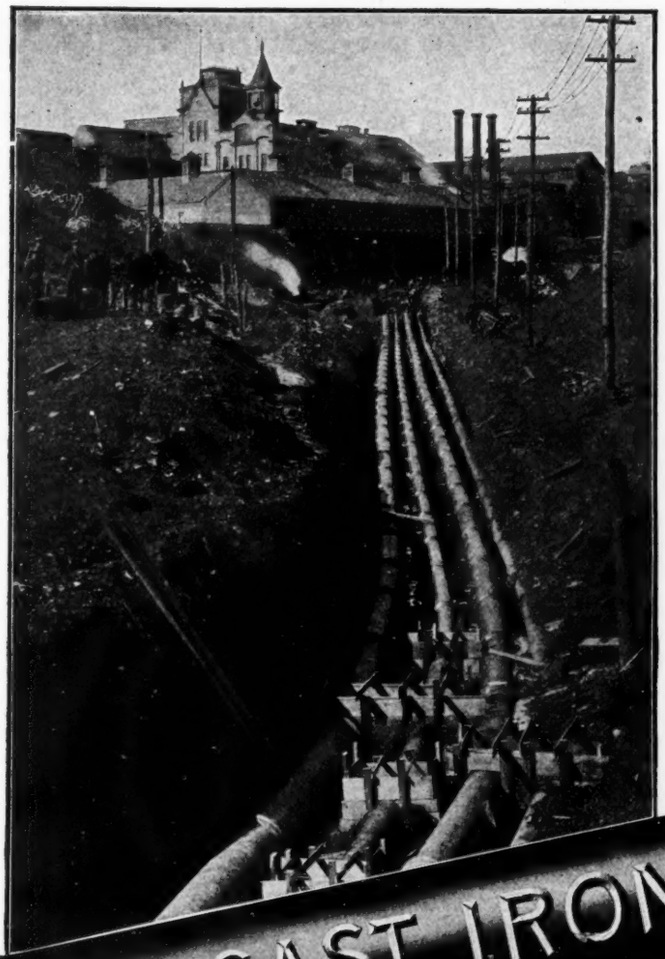
Poles (including crossarms, guys, etc.) in place	$ 7,000
Wire and insulators, in place	6,600
Total	$13,600

Under Culm-Banks

The relation of soil conditions to the life of underground piping is well recognized by engineers everywhere. No material is proof against all these conditions, but

Cast Iron Pipe

has proven its long life in numberless places where conditions are quickly destructive to other kinds of pipe.



Here is a picture of an installation of Cast Iron Pipe in the anthracite coal fields where soil conditions are most unfavorable. Note the culm bank to the right. The sulphur impregnated moisture from this bank has little or no effect on the pipe. Near this point is a line of 30" Cast Iron Pipe laid through a burning culm bank, where it has been subjected for nearly 10 years to high temperatures, sulphur gases, moisture and subsidence strains, without apparent damage.

THE FIRST CAST IRON PIPE EVER MADE IN THE WORLD'S HISTORY IS STILL IN SERVICE
SERVICE
CAST IRON PIPE
MEASURED BY
CAST IRON PIPE
CENTURIES
MORE THAN 250 YEARS OLD

The Cast Iron Pipe Publicity Bureau

1 Broadway New York

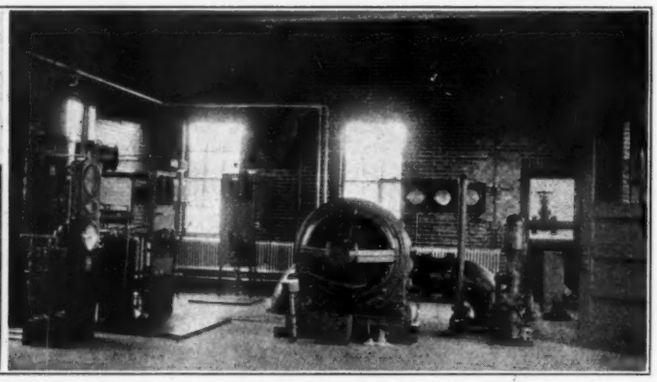


FIG. 3. GENERAL VIEW OF IPSWICH RIVER PUMPING STATION. FIG. 4. INTERIOR VIEW OF IPSWICH RIVER PUMPING STATION SHOWING PUMPING UNIT INSTALLED.

The line has chestnut butt-treated poles, 200 ft. span and a capacity of about 220 K. W. at 4,000 volts. It is about 6.5 miles long and thus cost about $2,100 per mile.

Concluding

The total cost of the Ipswich River supply to date (which includes some items not described above) is about $250,000. The city was very fortunate in completing practically all of this work. Acknowledgment is made for information and the war. To duplicate this work at present would mean an expenditure of upwards of a half million dollars.

The writer has acted as consulting engineer for the city on this work. Acknowledgement is made for information and courtesies extended in the preparation of this article by Mr. Reeves J. Newsom, Commissioner of Water Supply of the City of Lynn.

Some Economies That May Be Effected in the Operation and Maintenance of the Water Works System

By Homer V. Knouse, Assistant Superintendent and Purchasing Agent, Metropolitan Water District, Omaha, Neb.

While manufactured products of every nature have been advanced in price to the consumer, with reasons therefor that have been accepted, albeit with some grumbling, and while the cost of labor of every class has followed in order to meet the increased cost of those very necessities, it is a matter of considerable significance that the cost of service of publicly owned properties has not advanced in even a small fraction of the amount of other service, and in fact, in most cases there has been no advance at all, there being a few cases where it has been possible to continue the decrease of a rate at only a slightly lesser rate than in pre-war periods. And in the water works field has this condition been especially notable. The cases of increase of rates have been mighty few in number, and men responsible for these utilities may well feel that they have truly "done their bit" when they remained at home and combatted the enemy of high prices, generally in the face of an unsympathetic public, and always with the knowledge that there would be no "crosses for distinguished service." While we cheer the returning men in arms, we can feel that even though we have risked much less in many ways, we have at least made it a little easier for the industrial army behind the lines to meet the inevitable burdens imposed by war.

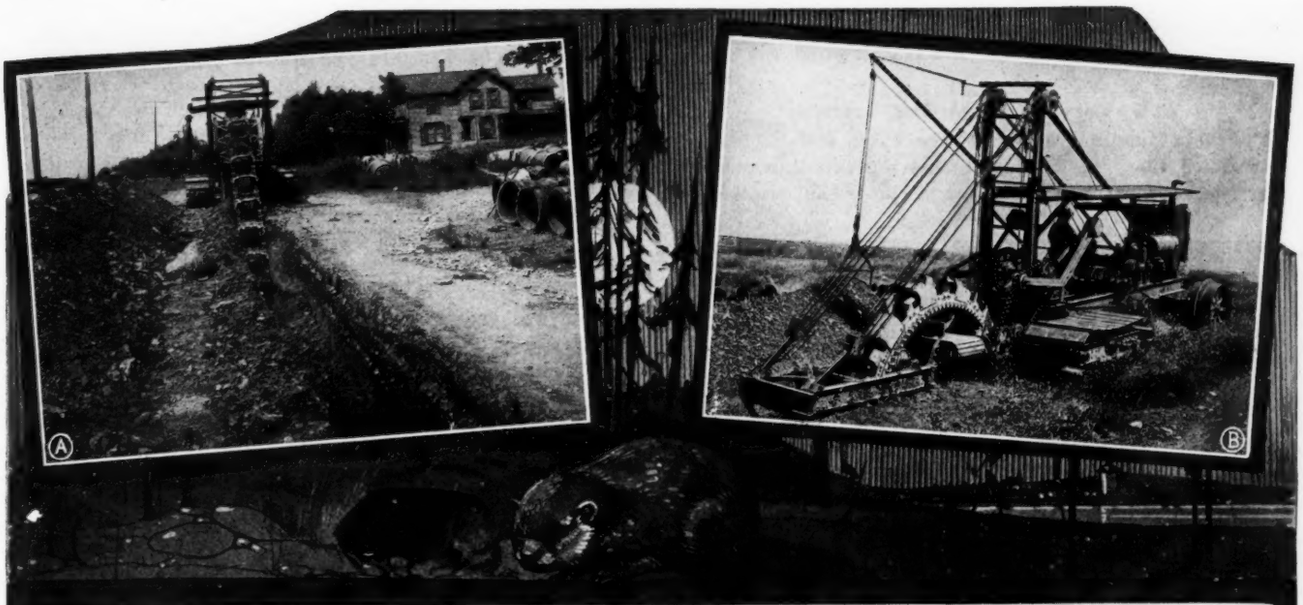
At the outset there is one thing that is emphasized by the writer, namely, that none of the plans carried out have been wholly new in the instance cited, but it is believed that in most cases they are adaptations of the plans of others, or have been suggested at times by very dissimilar proposals, and possibly may be even the carrying out in its entirety of the work of some other man. A great deal of credit must be given to the meetings of men interested in this line of activity, to the time that they have given to the preparation of papers, describing those things that they have attempted, as well as to those things which were crowned with success.

Organization of Metropolitan Water District

The Metropolitan Water District of the City of Omaha is a comparatively new property, if measured in the years that it has been under municipal control, although as a water system it had been in successful operation since 1880. Originally built by the American Water Works Company and successively under the control of subsidiary companies, to suit the various needs of corporate financing, it finally came under the control of the City of Omaha in July, 1912, and has since been operated under the title mentioned above. Just a brief word in regard to this form of government, for it seems to be a fact that cannot be disputed, that the form of control has been a large factor in the successful operation of the plant. The management is under the control of a Board of Directors which it was desired should be as nearly non-partisan as possible, and to secure such condition it was decided that the nearest approximation would be secured in a bi-partisan board. Each two years two members are elected, one from each of two political parties, and these men serve six years. The salary is merely nominal, and with a majority of the board holding over, a continuing policy is assured. This board appoints a general manager who is in responsible charge of the entire property, and appoints his subordinates with no other motive than to obtain those who will serve in such a manner as to get the results that the general manager must obtain to retain his position. Under this plan as applied, every department head is in actual charge of his department, selects his subordinates, is responsible for their efficiency, is brought to task for their failures, and reaps benefits of the successes of his department without the possibility of "passing the buck" either in his own mind or in actuality. Under this plan every employe is continually on tip-toe to make a record that will be to his credit, and in the last analysis it will remain an undisputed fact that the greatest economies in the operation of any enterprise will be from the whole-hearted co-operation and interest of the men making up its personnel.

Records of Operation

The logical step from individual efficiency is to mechanical excellence, and the factor which will control both are the records of the operation. This is a matter that every superintendent realizes, but in many cases is compelled to defer until a time when he has a few minutes free to get out the necessary forms and issue the requisite instructions to place in effect the ideas that have formulated in his mind. To often the many demands upon the time of the superintendent do not allow him to get further than this, and it is a regretable fact that this feature of the work is many times not in the form which would allow him quickly to locate the leaks that mean so much in economical operation. Just one instance to illus-



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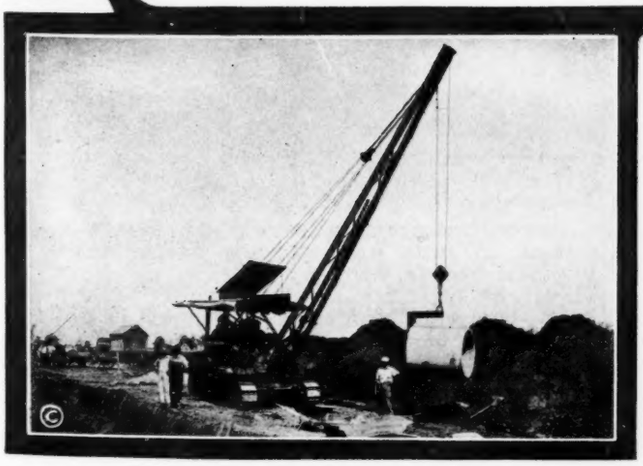
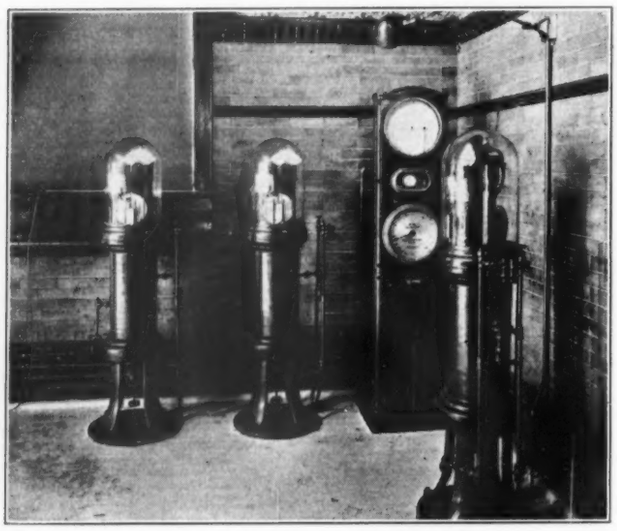


trate wherein a most decided economy has been effected at an expense that is insignificant compared with the results achieved.

Every Element Weighed or Measured

The main pumping station of the water district has been so arranged that every element entering into the operation of the plant is measured. Coal in and cinders out are weighed.



VENTURI METER REGISTERS ON LINES TO SEDIMENTATION BASINS TO CITY SYSTEM AND ON BOILER FEED LINES, OMAHA WATER WORKS.

Water pumped and water to each boiler and to each engine is passed through a steam flow meter. The water delivered to the settling basins and to the distribution system is passed through Venturi meters.

On the basis of this information there comes to the desk of the superintendent each morning a report showing in its final analysis a statement as to the number of foot pounds of energy developed per pound of steam in each engine, the number of pounds of water evaporated per pound of fuel in each boiler, the number of gallons of raw water pumped as well as the number of gallons of treated water put into the distribution system. Each engine and each boiler is watched, and the individual performance known each day that adjustments may be promptly made, and it is finally developed as to what the overall station duty is, and the number of pounds of water evaporated per pound of fuel burned.

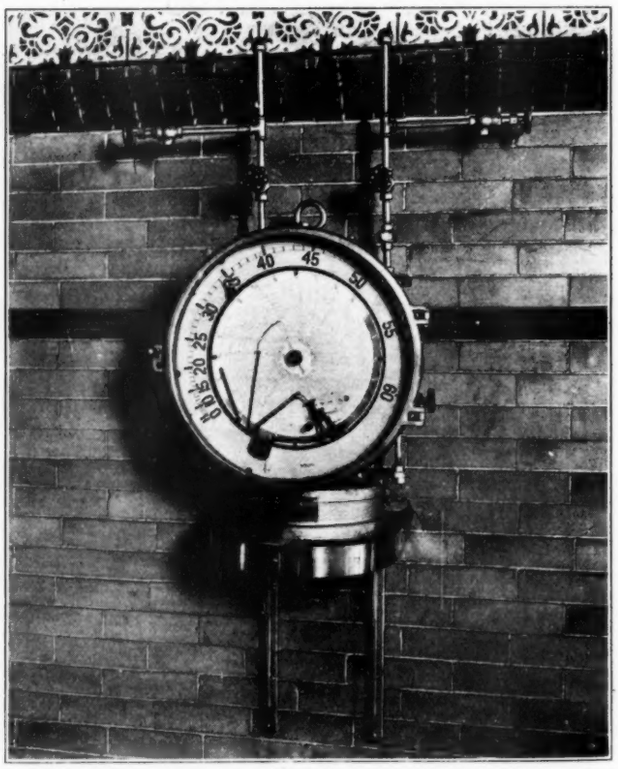
Testing Worth of Coal

Coal is the large factor in the operating cost and, therefore, this is the item in which the most interest develops. Knowing the kind of coal that was under the boilers, and of course its cost, it is a simple matter to determine the cost per pound of water evaporated, and it is at this point that the large factor of economy may develop. Probably every operator has had a salesman from one or the other coal district approach him with an argument as to why he should buy that salesman's coal in preference to all others, because it contained so many thousand B. T. U.'s, and the worst part of it is that the salesman has all the best of it, for one cannot dispute a fact that is usually attested by such authorities as we all know to be above reproach. We have a feeling that there are lots of things that we could tell him about our plant, and that there are some things that he does not know about burning coal under our boilers, but in view of the array of figures that he gives we are very loath to enter into an argument when we cannot quote data on the same basis of reliability as those that he quotes. The answer is simple, in the case under consideration, and the writer has found great satisfaction in being able to reach over the desk and pick up a report showing the performance of a certain coal and ask the salesman if he can guarantee his product to perform on an equivalent basis.

A concrete example will probably explain the method more clearly than would any further discussion in the abstract. The station duty for a certain date showed that when burning coal from a specified district an evaporation of 6.0 lbs. of water per pound of fuel from and at 212 degrees was obtained in all the boilers, and from a knowledge of previous days' reports it was known that this was a fair average for this coal. The coal cost on cars at the plant was $3.50 per ton. The coal offered was quoted at $4.85 and it was a very simple problem in proportion to determine that in order to be as cheap as the coal being burned, the coal offered would have to develop an evaporation of 8.3 lbs. of water per pound of coal. Previous experience with coal from this district had told us that such evaporation was very improbable, and consequently we were not deceived by any claims that were not available under our particular operating conditions. A similar process of reasoning shows the price that may be paid for any other coal, for past tests are on record showing what may be reasonably expected from many different fields. It is difficult to estimate what the net saving has been to the water district from this method, but the writer is confident that it is very large.

Economy of Alum Cake Plant Demonstrated

Probably the next largest item that enters into the operation of this particular plant is the matter of coagulant for the settling of the water, and those who are familiar with the natural state of the waters of the Missouri, or perhaps better known as the "Big Muddy," can realize that it has been no inconsiderable item. Prior to the year 1916 commercial sul-



MASTER GENERAL ELECTRIC CO. STEAM FLOW METER, ON MAIN HEADER FROM BOILER ROOM TO ENGINES, OMAHA WATER WORKS.

phate of alumina was used as a coagulant, but in that year a plant was placed in operation to manufacture a material which served the purpose in as efficient a manner and had the advantage of considerable economy. This is an alum cake plant, as developed by Mr. Charles Hoover at Columbus, Ohio, and the operation over a period of three years has demonstrated

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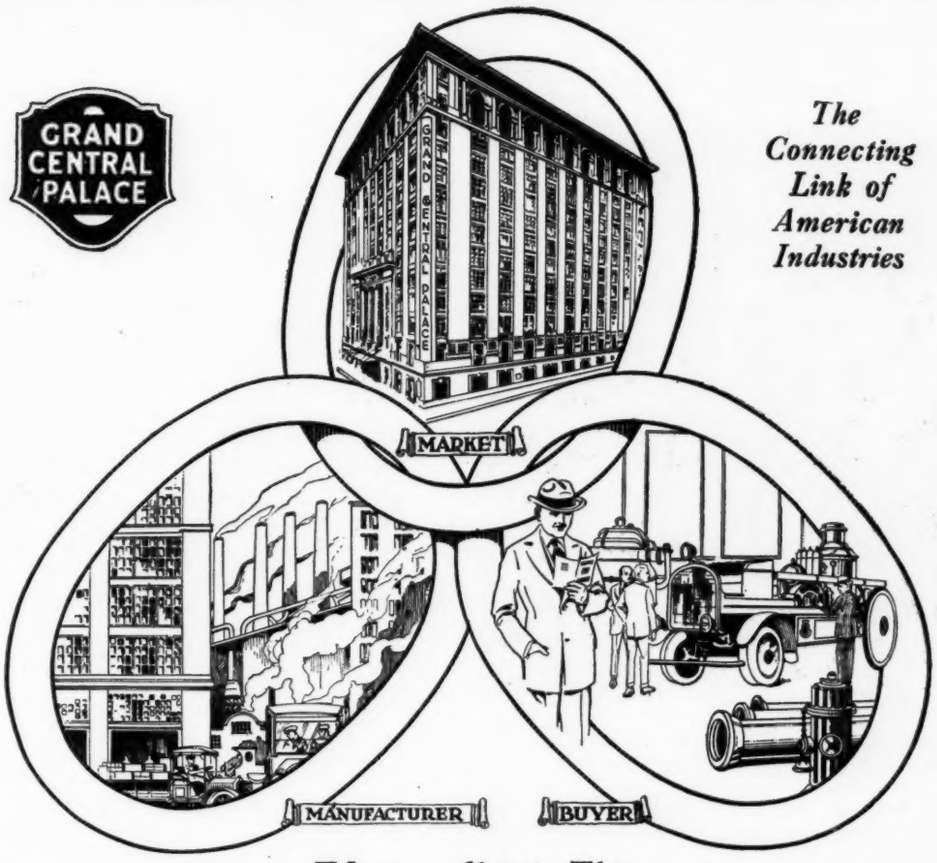

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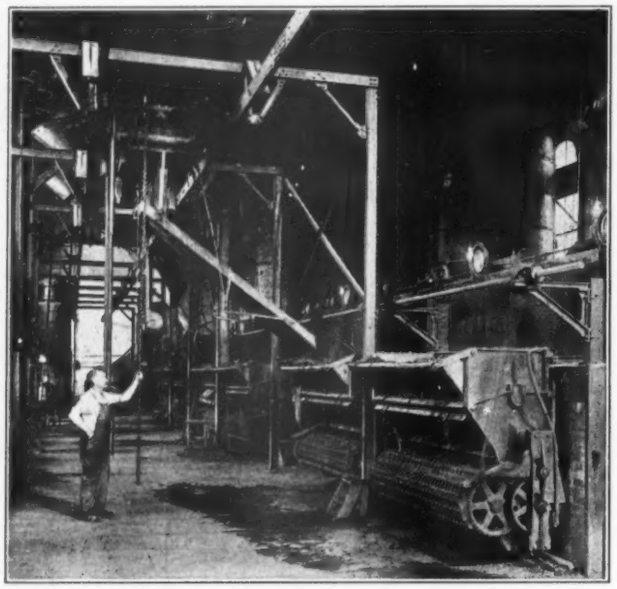
its economy in a manner that is almost too good to be true. The raw materials are bauxite, obtained in Arkansas, and sulphuric acid. The manufacturing process is very simple, and even the machinery in use could well be replaced in many instances by a few simple tools, and a cheap installation that would reduce the investment to a negligible figure. A product



SECTION OF BOILER ROOM OF OMAHA WATER WORKS SHOWING EQUIPMENT WITH WEIGHING HOPPER FOR WEIGHING COAL TO EACH BOILER.

is obtained that is fully as efficient as a coagulant as the commercial product, is no more expensive to handle, and the cost of $0.60 per hundred represents a substantial saving over what would have been the cost had a contract offered in 1916 been accepted. In fact, figured on this basis, the net saving for 1918 was $15,000 on a plant equipment cost of $6,500.

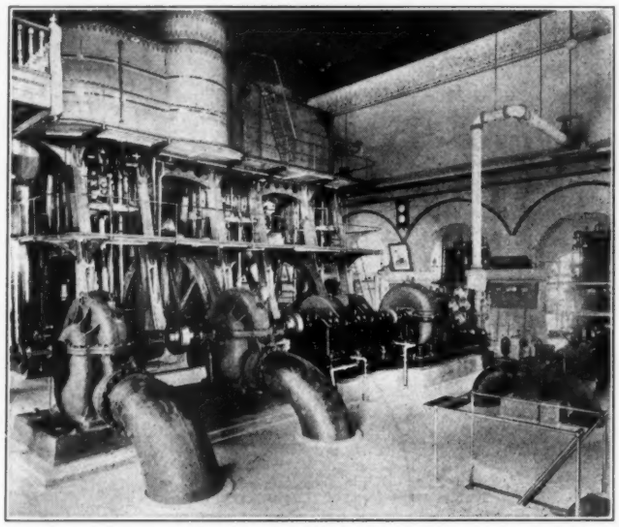
Many special rigs, a number of plans for the handling of work, and not a few just plain "fool ideas" have been advanced, and to tell the truth almost that many have been discarded as being more bother than they were worth. But from the fact that even a few were worth the time spent on the whole lot, and that these few will lead to the development of others, that work along this line is very much worth while. A few will be mentioned:

Folding Ditch Barricade

A folding ditch barricade, so arranged that for transportation from yard to job a minimum of space would be required, with provision for suspending a red lantern in a secure manner, and being so painted that it was conspicuous under an automobile headlight, was a cheap device that has proven of considerable value. With the lantern supported from the top of the frame and the bail removed, it has been noted that the lanterns were not nearly so popular with the early morning milkman as were those whereon the bail was left in place.

Modified Uses of Motor Trucks

A tee placed in the exhaust line from the motor of a 2-ton

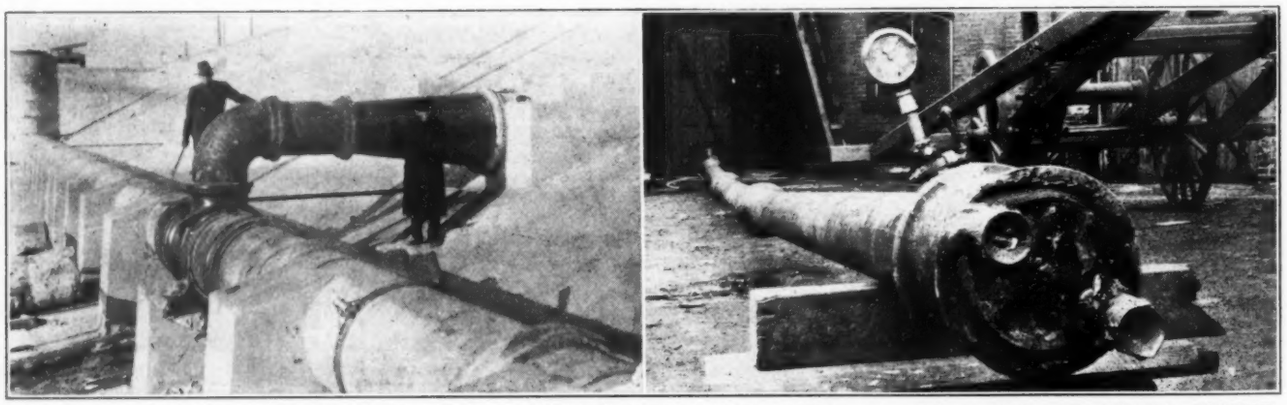


MAIN HIGH SERVICE PUMP ROOM OF OMAHA WATER WORKS, SHOWING DE LEVAL 30 MILLION HIGH SERVICE PUMP IN FOREGROUND, 20 MILLION ALLIS IN BACKGROUND AND 18 MILLION ALLIS IN DISTANCE.

truck, to which was connected a flexible metal hose, proved to be a most useful piece of equipment, for it often saved the expense of sending a steamer for the thawing of a hydrant. Another modification applied to the truck was the attachment of a coupling device to the body, and the fitting of suitable attachments to the tongues of all tool wagons, concrete mixers, trailers for the transporting of large pipe, trench pumps and other wheeled tools. Much time was saved, and an added security obtained that is difficult to measure in dollars, but which the operating official will recognize as being a real advancement.

Foreman's Map of Distribution System

Another tool, if it may be given such a name, that is present in some plants, and also absent from a considerable number, is a map of the distribution system that has been compiled with the idea of usefulness to the foreman on construc-



VIEWS ILLUSTRATING SUCCESSFUL APPLICATION OF METALLIUM JOINTS IN PIPE LINES OF OMAHA WATER WORKS.

Left: Pipe Work Using Metallium Joints. Right: Test Section of Pipe Showing Deflection after Pouring of Joints.

tion and repairs. The "Big Boss" usually has a big map of the system in his office, and the chief engineer has a lot of tracings that tell him just the things that he wants to know, but too often the man on the job is left with an out-of-date blue print with innumerable scratches thereon in pencil, or in many cases he is compelled to rely on a memory already overtaxed with things that the super has told him to do as soon as he has the time. To help out this worthy individual a skeleton map was drawn on a scale of 600 ft. to the inch, and cut up into sections covering a district one mile by two miles. These maps, printed on cloth, were bound in a roll or cover having a snap clasp and which, when not in use, occupied a space of about 3 ins. by 3 ins. by 11 ins. Shown thereon are mains, valves and hydrants only, with a numeral alongside the main to indicate its size. Its usefulness has been well proven, for even the memory of the oldest foreman will at times prove to be faulty, and especially so under the stress of a shut-out around a break where the flowing water is causing considerable damage.

Fifty Miles of Main Successfully Laid with Metalium Joints

Much stress has often been laid upon one characteristic of water works men, and the writer feels whenever he hears it mentioned in terms of criticism that it is instead a most flattering compliment. It has been given two or three names, depending upon the size and position of the man addressed; sometimes it is politely mentioned as conservatism, and again someone had the temerity to call it by the name of bull-headedness. But in the light of the results that have been achieved during the war period it must be apparent to everyone that there is some unnamed quality in these men that has made for safe and economical operation of the properties entrusted to their care. It is this quality that has undoubtedly safeguarded the owner, whether public or private, of the water works of the country against many proposals that had not had a sufficient time for trial, and which might have proven of great disadvantage to the plant in many ways.

It was probably this natural conservatism that made the management of the water district hesitate to try a substitute for lead as a jointing material in the laying of bell and spigot water pipe. However, upon close analysis it appeared that lead was not an entirely satisfactory material for this purpose, and an investigation was made with a view to determine its failings, and to investigate the claims of those who offered substitutes that their assertions as to superiority over lead might be substantiated. In was in 1914 that the Metropolitan Water District began this investigation, primarily with a view to decrease the cost of construction of a large force main, but also with the idea of eliminating some of the difficulties that were inherent with lead, and to which years of use had made them somewhat callous. Chief among the difficulties was the increasing difficulty of paying the increasing scale of wages demanded by expert caulkers, and even of obtaining the services of competent men for this class of work at any price; the time necessary for the caulking of the joint before the ditch could be refilled or the pipe placed in service, and the necessity for testing the line before the refilling of the ditch due to the inability of the caulking material to take up any initial leakage. All of these factors proved to be items of considerable expense due to delays to the pipe gangs.

It was during the first day that the greatest number of objections to the new material presented themselves, for after the foremen and the workmen had become familiar with the slightly different methods of handling necessary with the improved joint a decided speeding up of the work was apparent, and when it was considered that even with the pre-war prices of lead effective that there was a saving on material alone of about $1.10 per joint, the troubles of the first day were forgotten. The workmen's attitude changed from one of skepti-

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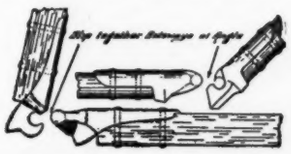

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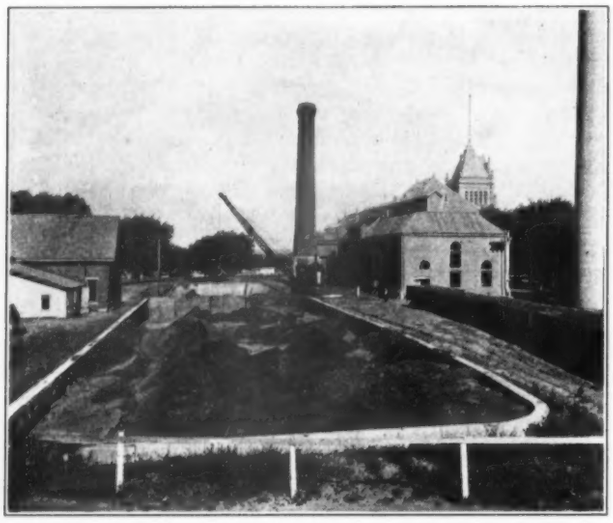
cism to one of enthusiasm, until at the present time there would be decided objections to going back to lead.

The year following all lines, of every size, were laid with this material, and the practice has continued to the present. Many joints have been uncovered to see what their condition was after several years of installation and it has been with a great deal of pleasure that the management has noted that there has not been the slightest change during the period of use. Lines under pressure have been lowered as much as 3 ft. with only a slight leakage immediately after deflection, and which has in every case taken up as rapidly as would any slight leakage that might occur when pressure was applied after the initial installation. There has been greatly decreased trouble in joints under railroad tracks, where the tendency has been for lead to "walk out" of the joint, and it is now



COAL PITS HAVING A SUBMERGED STORAGE CAPACITY OF 8,000 TONS, OMAHA WATER WORKS.

general practice in this department to peel the lead at the first sign of trouble and replace with metalium.

A number of instances might be cited where metalium has been useful for special jobs where no other product would be suitable, but when once its use is begun these adaptations will be apparent to the superintendent and foreman. With more than 50 miles of main laid with this material, and the joint troubles practically nil, it is felt that the management was more than justified in giving the city the benefit of greatly reduced costs with an increased efficiency.

Acknowledgment

The foregoing paper was presented at the recent annual convention of the Southwestern Water Works Association.

Most Recent Developments in the Methods of Measuring Irrigation Water to Farms and Irrigators

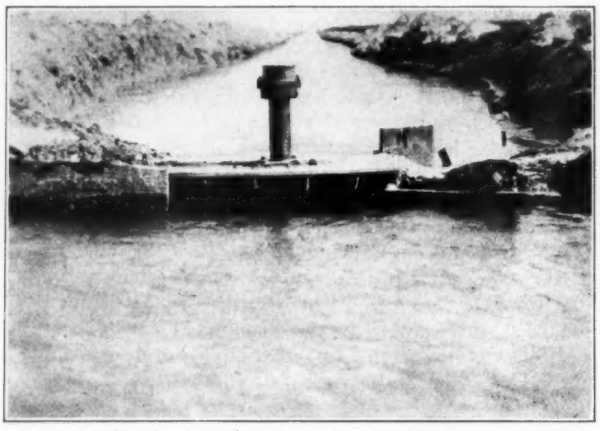
By F. E. Trask, C. E., Consulting Civil and Hydraulic Engineer, 616 Union Oil Bldg., Los Angeles, Calif.

For a period of 32 years the writer has been intimately connected with all phases of the engineering problems involved in the development and operation of irrigation projects in the southwestern portion of the United States.

Of the multitudinous problems confronted in all these years, none have been more difficult of satisfactory solution than that presented in the effort to obtain accurate measurement and correct knowledge of the volume of water delivered to the irrigator.

Old Methods and Their Limitations

The writer has read and heard much discussion of this subject, and to those who may desire more detailed informa-



TWO SECOND FOOT RELIANCE IRRIGATION METER OPERATING IN AN EARTHEN CANAL.

tion thereon, he would refer to issues of Engineering and Contracting of dates November 13, 1918, and February 12, 1919, wherein engineers of the United States Reclamation Service emphasize the great importance, to all parties in interest, of an accurate knowledge of the exact volume of water delivered to each farm; and the further fact, that, within reasonable costs, there are none of the old enumerated methods that are satisfactory in practical service.

The writer is in hearty accord with most of the argument and conclusions presented in the mentioned article; and further is firmly convinced that the "weir," and "Venturi tube" will always be used to some extent, where special conditions operate to make such use commercially practicable. How-

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ever, for most headworks and lateral canal intake measurements and all measurements for deliveries to individual irrigators much use will be made of a new device or meter, now on the market. The conservative business methods of the owners of this meter are wholly responsible for its being so little known today, and when engineers are acquainted with its merits, it will be as important in irrigation works designs and specifications as are pressure meters in domestic water works equipment.

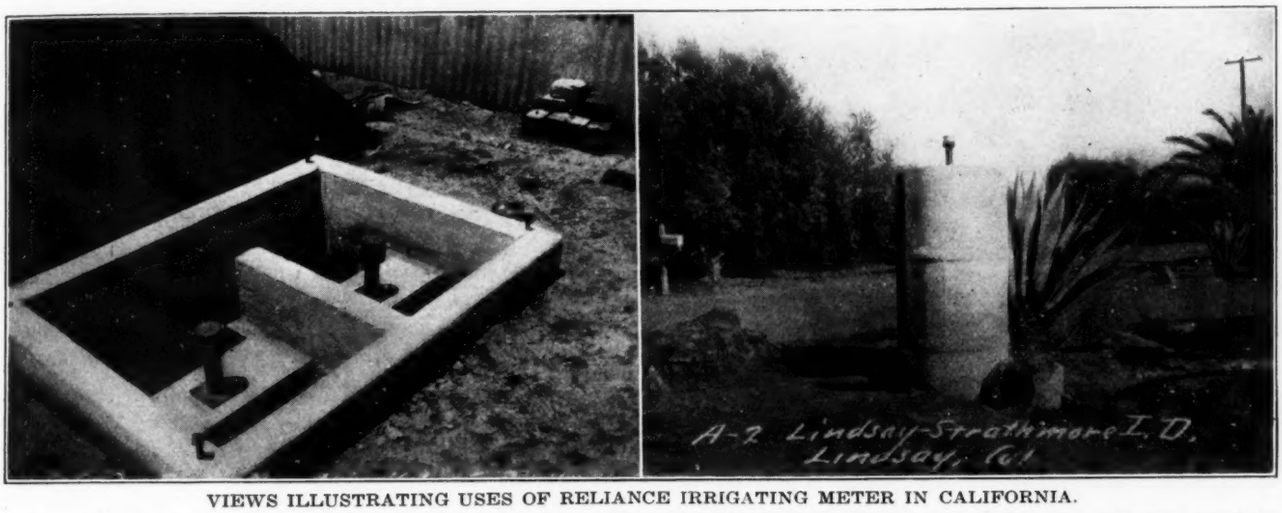
The writer has been watching this meter for more than two years and is now convinced of its merit to the extent that he is specifying it in all new work and adding it to the weir boxes in many of the older irrigation systems.

ment of the meter that the error is usually within one-half of one per cent., when checked against a well conditioned standard weir. Volumetric tests, made by discharging into calibrated reservoirs have given substantially the same results.

Merits of Metering .

The writer has been active in urging that all classes of water services should be metered; and within the past year has been able to apply, to all water services, the same methods heretofore commercially possible only for domestic services, and do so with great satisfaction to all parties concerned.

Metering irrigation water is the sole method of eliminating friction between a company and its consumers. The scien-



VIEWS ILLUSTRATING USES OF RELIANCE IRRIGATING METER IN CALIFORNIA.

Left: Setting and Measurements of Water in and From an Old Weir-Type Measuring Box. Right: Example of Method Used by the Lindsay-Strathmore Irrigation District.

The New Method of Measuring Irrigation Water

The Hydrometric Company of this city has placed this irrigation meter on the market under the name "Reliance Irrigation Meter," and it has been tried out under all possible conditions with general satisfaction.

In a nutshell, this meter may be described as a "calibrated throat," in which is suspended a "propeller wheel," connecting directly by rod to a "gear train" having a dial, from which may be read directly the volume of water, either in "acre feet" or "cubic feet" as may be required.

This is not an integrating meter as the whole body of water, in ditch or pipe line, passes through the meter.

Likewise, it is not a 'pressure meter" but can be readily adapted to non-pressure irrigation conduits, sewerage and drainage conduits, and domestic water reservoir intakes. The three photographs represent the regular uses to which the meter is being applied in this state. The first shows a "two second foot" meter, operating in an earthen canal; the second illustrates the setting and measurements of water in and from an old weir-type measuring box; and the third is an example of the method used by the Lindsay-Strathmore Irrigation District, which has three meters installed throughout its irrigation pipe system.

Sizes of Meters

These meters are built with capacities varying from 1/5 to 16 second feet, and the writer finds it very easy to design a canal section in such a manner that any volume of flow can be measured by installing duplicate meters in battery form.

Degree of Accuracy

The makers' tests show the meters to register within 2 per cent. when operating from one-half to full rating. It has been found that under normal conditions and careful place-

tific farmer may now measure accurately the right quantity of water for his crops, and do so without waste or unnecessary expense.

Meters eliminate disputes, litigation, and trouble and worry for engineers and superintendents. The cost of installation is moderate and within the reach of every irrigator.

Building Up a Worn Pump with the Oxy-Acetylene Process

By Charles C. Phelps, Engineering Department, Oxweld Acetylene Co., 30 East 42d St., New York, N. Y.

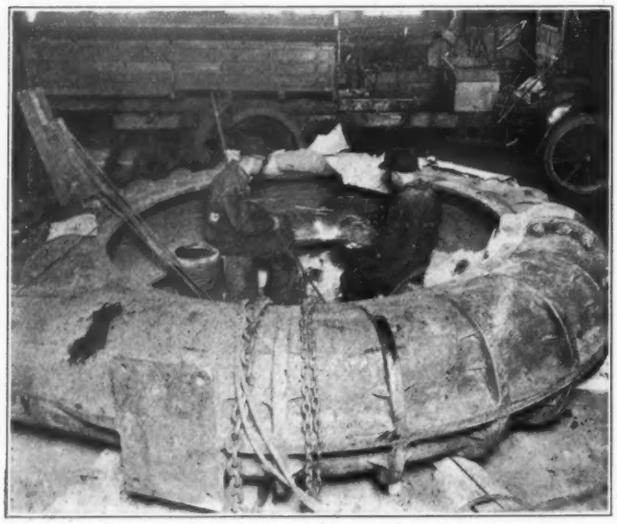
The type of centrifugal pump used by dredging contractors and mining operators for such purposes as dredging silt, sand, mud and gravel from the bottoms of channels and for mining soft ore by the hydraulic mining system, is subject to excessive wear, due to the constant abrasion of the sand and gravel against the inner walls of the pump chamber. When the wear becomes so great as to interfere with the operation of the pump, or "sand sucker," as it is commonly called, it becomes necessary not only to put the pump itself out of commission for repair but also to hold an expensive dredging barge and its crew in idleness.

Such a sand sucker chamber that had become badly scored through use was recently restored to practically its original condition by the Chicago Job Welding Department of the Oxweld Acetylene Co., by means of the oxy-acetylene process. When it is considered that new castings would have cost about $3,500 and that the actual cost of repairing by welding methods amounted to only one-third as much, it is not surprising that the contractor decided to repair instead of to replace, especially in view of the still more important fact that repairing enabled him to get the dredge back into service with only a

few days' delay, whereas replacement meant a delay of from 10 to 12 weeks.

Delay Meant Great Loss

In order to gain some idea of the cost of delay of a hydraulic dredging outfit an estimate of the earnings of a dredge will be given. In the year 1912 the United States Government estimated the cost of hydraulic dredging to be 7.18 cts. per cubic yard. This figure represented the average total unit cost of operating a fleet of hydraulic dredging vessels. The record for



BUILDING UP WORN SURFACE OF "SAND SUCKER" DEPOSITING 1,264 LBS. OF HIGH CARBON STEEL WITH AID OF OXWELD OXY-ACETYLENE BLOWPIPES.

one month for one dredging pump having a 20-in. outlet pipe was 456,000 cu. yds. of material. At the average unit cost given above, the monthly cost of dredging this amount of material represents over $30,000. The sand sucker shown in the illustration is much larger than the one referred to above. Furthermore, the cost of materials and labor is much greater today than in 1912. When such factors as loss of profits, overhead expenses, non-productive labor and contract penalties are taken into consideration, obviously every week of idleness meant a loss of thousands of dollars.

Over Half Ton of Metal Deposited

The pump chamber of the sand sucker illustrated is 14 feet in outside diameter, and consists of two massive steel castings having a total weight of 7 tons. The abrasion had been so severe it was necessary to rebuild both side walls of the pump chamber for a distance of 8 ins. from the inner circumference. The thickness of the added metal varied from 1½ to 2½ ins. In addition, a new section approximately 14x18 ins. in area had to be welded into the throat of the casting. The latter was approximately 3½ ins. in thickness.

In order to insure holding the two halves of the chamber in alignment during preheating and welding they were bolted together and the heavy outer reinforced sections of the castings were not heated, as this would have produced internal strains, either breaking the castings or shearing the bolts that held them together. Preheating by means of charcoal was applied locally for a distince of about 14 ins. in from the edges of the flanges, each preheat extending for a distance of 3 ft. around the inner circumference.

The total weight of steel added to the castings by welding amounted to 1,264 lbs. The operators, each using an Oxweld blowpipe fitted with No. 15 welding head, worked in pairs. As the heat in the small enclosure where the men worked was intense, it was necessary to hold several welders in reserve and to work on the relay plan, each welding shift extending for a period of 20 minutes. Six days were required to complete the building-up work.

Construction Improved by Use of High Carbon Steel

As the built-up surface will be subjected to the same abrasive action of sand and gravel, high carbon steel welding rods were used for the purpose of building up, thereby giving an extremely hard surface, in fact, one that it was impossible to cut with a file, after cooling.

The oxy-acetylene welding work was completed in six days, saving the contractor the expense of several weeks of idleness, nearly $2,500 in cash on the cost of the casting alone, and giving him a pump actually improved in construction, because lined with abrasion-resisting steel.

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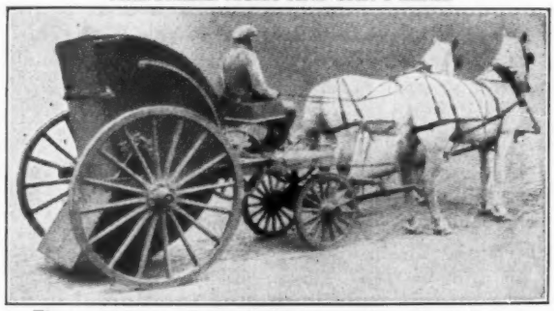

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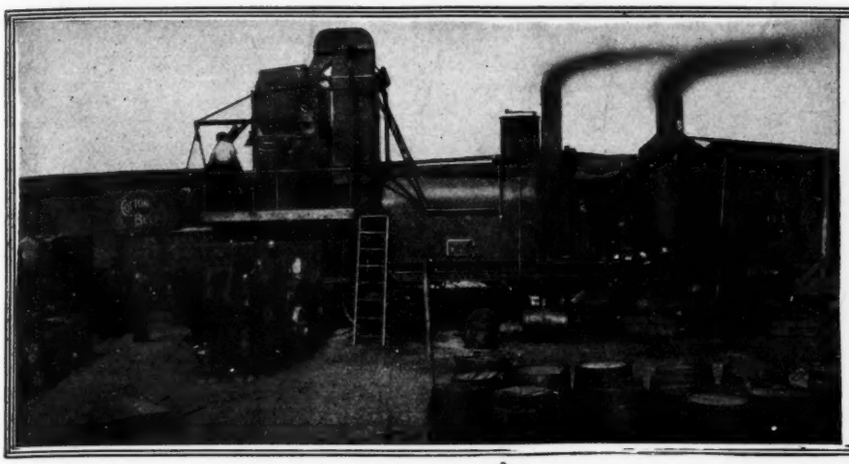

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Contracts Awarded

ROADS AND STREETS.

Ala., Birmingham — Patrick Wallace, Bessemer, Ala., awarded contract by Jefferson County Commrs. for grading 14 miles of road and surfacing 15 miles of road with broken stone at $147,500.

Ala., Birmingham—Following contracts for road imprvts. in Jefferson county (35 miles) let by Board of Revenue: McCalla-Buckville Road, 3½ miles to Jno. & Iva Parsons Constr. Co., at $25,488; Taylor's Ferry Road, 5½ miles Oak Grove-Lock, 17 Road, 7 miles, Gilmores to Alliance School House, 2½ miles, Chert on 5 miles Oak Grove Road, Alliance School House to Maxine, 4 miles chert all to Pat Wallace at $43,095, $52,120, $8,500, $14,508 and $10,400, respectively; Gintown-Flat Top & Bessie Mines Road, 7 miles, to Acton & Self, at $26,500; J. B. Ryland, Contr. for Edgewater to Max Chapel, at $8,405.

Ala., Birmingham—The following contractors awarded contracts by the Jefferson County Board of Review: Southern Bitulithic Co. for 5 miles of bituminous paving on Mt. Pinson Road at $192,926; Lawrence Construction Co., for 5 miles of plani concrete on Jasper Road at $213,577; J. F. Morgan, for 5.72 miles of sheet asphalt on Southern Bessemer Road at $259,821; Southern Bitulithic Co., for 3.82 miles bitulithic paving on Old Stout's Road at $166,-777; Southern Bitulithic Co. for 4 miles bitulithic paving on Montgomery highway at $174,597; and, W. T. Taylor Construction Co. for grading 3.2 miles of the Lovick-Leeds Highway at $48,663.

Ala., Mobile — Jett-Muths Construction Co., Mobile, awarded road contract at $38,-732; Southern Bitulithic Co., Nashville, Tenn., awarded contract for bitulithic pavement at $117,690.

Ala., Mobile — Toulmin & Company awarded contract by Mobile County Commrs. for gravel surfacing 7.1 miles of state trunk road No. 1 at $50,000.

Ark., Ashdown—C. A. Reese and Company, Muskogee, Okla., awarded contract by road improvement district No. 7, Little River County for constructing 69 miles of roads at $523,600.

Ark., DeWitt—The Southern Improvement Co. awarded contract by the commrs. of Road District No. 5, Arkansas County for constructing asphalt pavements in the district named at $1,718,276.

Ark., Fayetteville—Crane Constr. Co., Springfield, Mo., awarded contract for bldg. 52 miles waterbound limestone and gravel macadam road and 2 miles bitum. macadam road at about $385,000.

Ark., Forrest City — Roach & Shufod, Memphis, awarded contract for construction of approx. 17 miles of road northeast from Lee County line via Hughes to Blackfish, St. Francis County road district No. 4 at about $160,000.

Ark., Little Rock — Moreno-Burkman Construction Co., St. Louis, awarded contract by State Hwy. Dept. for surfacing Little Rock-Hot Springs Hwy. from Mo. Pacific Viaduct to Pulaski County line at $207,791.

Ark., Little Rock—Walter H. Dennison, Cushman, awarded contract for constr. of nearly 80 miles of improved hwy. in No. Ark. Rd. Impvt. District No. 2 of Izard, Fulton and Independence Counties, at approx. $650,000.

Ark., Marion—R. G. Hill & Co., Birmingham, Ala., awarded contract for 11 mile road between Memphis, Tenn., and Marion and Memphis and Hulbert; road embankment, 120 cu. yds.; $69,300.

Cal., Fresno—Thompson Bros. awarded contract for paving both F and N streets at $6,040 and 40,949, respectively.

Cal., Los Angeles—Peter L. Ferry, 614 E. Acacia avenue, Glendale, awarded contract for constructing paved hwys. from Lomita to Wilmington and San Pedro in Municipal Impvt. Dist. No. 7 at $156,093. (concrete paving.)

Cal., Martinez—A. H. Copperud, Byron, awarded contract for surfacing with asph. 3.7 miles concrete hwy.—Pittsburg to Antioch—at $33,988.

Cal., San Bernardino—R. T. Shea Co., Riverside, awarded contract for constructing about 2½ miles of concrete roadway and stone curbs on Hermosa avenue Impvt. Dist. No. 7, at $54,740.

D. C., Washington—Cranford Paving Co., Union Trust Bldg., Washington, awarded asphalt paving contracts amounting to $650,000.

Fla., Bunnell—C. A. Smith, awarded contract for 26 miles grading, draining, structures and wooden bridges in Shell Bluff Special Road and Bridge Dist. at $100,000.

Fla., Gainesville—Finley Method Co., Houston, Tex., awarded contract by the state road department for constructing 11.75 miles road No. 2 of bituminous macadam with concrete curb at $186,000.

Fla., Milton — Southern Clay Mfg. Co., Chattanooga, Tenn., awarded contract by state road department for constructing 6 miles of grouted brick with concrete curbing on road No. 1 in Santa Rosa County at $113,000.

Idaho, Rupert—C. H. Helmer, Twin Falls, awarded contract for paving 12 blocks of city streets with bithulithic pavement, concrete base, at $111,723.46.

Ill., Chatsworth—Cole & Fauber, Chicago, awarded contract for hard road running south into Germanville from Chatsworth at about $60,000. State furnishes the cement and supervises the work which will cost about $15,000. The road will be of concrete.

Ill., Chicago—The R. F. Conway Co., Chamber of Commerce Bldg., Chicago, awarded the contract for constr. the first section of the Chicago-Milwaukee Road at $575,000. Same company also awarded a piece of road constr. between Morris and Ottawa, Ill., at $675,000.

Ill., E. St. Louis—Keeley Bros., City, awarded contract for constr. of section 29 of the new national hwy., at $58,861. The road will be of concrete and is a trifle over 2 miles long.

Ill., Galesburg — Graham-King Constr. Co., City, awarded contract for paving Monmouth Blvd. at $40,120.

Ill., Ottawa—The R. F. Conway Co., Chamber of Commerce Bldg., Chicago, awarded the contract for constructing the Ottawa-Morris Federal and State Aid Rd. at $675,000. The road is 20.7 miles long and work will be started at once.

Ill., Ottawa—The Warner Construction Co., has the contract for constructing section N15-D and B, amounting to 4 miles of construction at $149,000.

Ill., Ottawa—Central Engineering Co., Davenport, Ia., awarded contract for construction of section M, Federal Highway through LaSalle County at $68,570.

Ill., Springfield—Following contracts let by Department Public Works for road construction: Sections S and R, Springfield-E. St. Louis Hwy., Madison County, to Hug Lumber and Constr. Co., Highland, at $164,529; Section 28, National Hwy., St. Clair County, to Powell-Jauen Concrete Products Co., Collinsville, at $73,483; Section 29, National Hwy., St. Clair County, to Keely Bros., E. St. Louis, at $58,861; Section 30, National Hwy., St. Clair County, to Powell-Jauen Concrete Products Co., Collinsville, at $26,184; Section M, Morris-Henry Hwy., Lasalle County, to Central Engineering Co., Davenport, Ia., at $68,-578; Section 16, Lincoln Hwy., Whiteside County, to Schmidt Bros., Chicago, at $58,762.

Ill., Springfield—H. H. Hall & Company, E. St. Louis, Ill., awarded contract by state highway department for constructing sections U and Q, in Madison County, on the Springfield-E. St. Louis Highway and sections P and 32, in Madison County, on the National Highway, at $367,000.

Ind., Noblesville—E. G. Gant, Greenfield, awarded contract for constr. of Rooker Blvd., at $105,489.

Ind., Plymouth—Becker & Enyart Co., awarded contract for bldg. Michigan Road—Plymouth to St. Joseph County line—8.39 miles, at $274,419.

Ind., Columbia City—Following contracts let by State Hwy. Department: No. 1—Lincoln Hwy., Elkhart county, 6.35 miles, to Keith-Riley Constr. Co., (conc.) at $248,-974; No. 10—Michigan Road, Marshall County, 8.39 miles, to Becker-Enyart Co., (conc.), at $274, 419; No. 11—Lincoln Hwy., St. Joseph and Elkhart Counties, 3.5 miles, to Northern Constr. Co., (conc.), at $117,-088.

Ind., Rochester—Sparks and McClamrock, Laporte, Ind., awarded contract by Fulton County Commrs. for gravel road construction at $62,500.

Ind., Seymour—Davis Constr. Co., Arcadia, awarded contract by Jackson County

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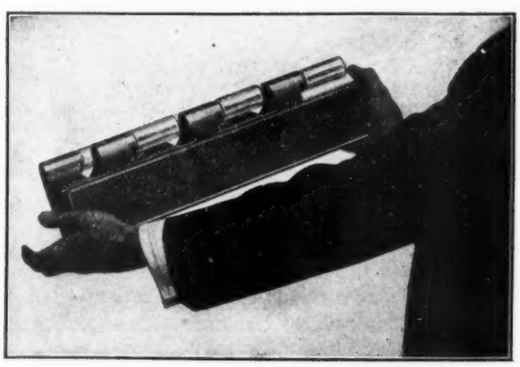

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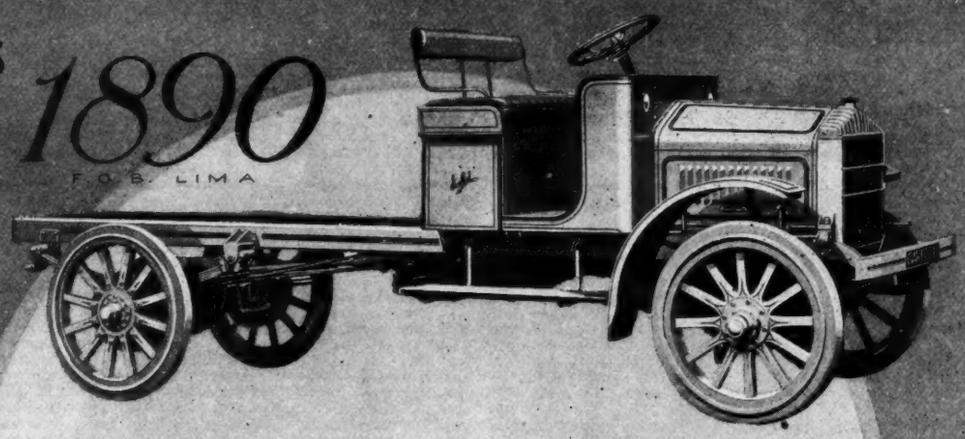

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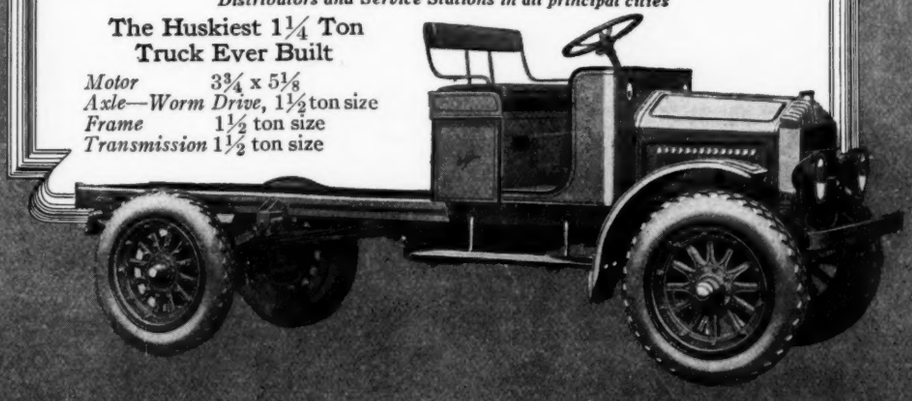

Commrs. for constr. of 2 miles conc. rdway. at $48,500.

Ia., Council Bluffs — L. J. Wickham, awarded contract for paving, sidewalks and sewer work; Peter Nelson awarded contract for curb and gutter work. Approx. $600,000 involved in the contracts.

Kans., Kinsley—M. R. Ammerman, Salina, Kans., awarded contract for about 18,813 sq. yds. paving at $83,105.

Kans., Leavenworth—Jas. Stanton, city, awarded contract for paving in Arkansas City, Kans., at $175,000; 45,000 cu. yds. paving and 30,000 cu. yds. grading.

Kans., Sebatha—Stanton & Son, Leavenworth, awarded contract for 7 blocks of paving on Main street at $100,770.

Kans., Seneca—Stanton & Son, Leavenworth, awarded contract by city council for 7 blocks of paving on Main street at $100,770.

La., Vidalia—S. A. Garmo, Contractor, awarded contract by State Hwy. Dept., for constructing 19 miles of gravel road between Vidalia and Clayton, at $225,000.

Md., Baltimore—P. Glanigan & Sons, Hartford Rd. & Balt. & O. R. R., awarded contract for repairing streets in various sections of city, sheet asph. block, cement and Belgian block, at $42,515.

Md., Frederick—M. J. Grove Lime Co., Lime Kiln, Md., awarded contract for 2 mile Federal Aid Road at $55,182.

Mass., Boston — Central Constr. Co., awarded contract for repairing bitum. pavement in any street in Boston not under guaranty, at $65,450; Standard Engineering Co., contract for repaving rdway. of draw span of Chelsea Bridge, No., at $13,621; Jas. Doherty, contract for bitum. macadam pavement in Faywood avenue—Orient avenue to Tower street—at $10,229; Rowe Contracting Co., contract for Topeka pavement in Atwill Road—Park street to Richwood street—at $3,244.

Mich., Kalamazoo—H. A. Hoxie, Grand Rapids, Mich., awarded contract for 2 pieces of concrete road construction in Kalamazoo County on the Trunk Line Hwy., between Kalamazoo and Three Rivers, at about $150,000.

Mich., Port Huron—Jas. Baker & Sons, will be awarded all contracts for street improvements (8 in number) at about $238,000.

Minn., Brainerd—General contract let following State Road No. 2: Emil Zontelli, Ironton, $71,118; Div. B; Frayen Bros., Palisade, $33,670. Div. A; E. J. Fennelly, brdgs., Aitkin, at $11,830; Atlas Culvert Co., culverts, Aitkin, at $2,182.

Minn., Faribault — Siems, Helmers & Schaffer, St. Paul, awarded contract for Jefferson Hwy. paving between Northfield and Faribault, at $388,862.

Minn., Mantorville—Fulton & Nelson, Minneapolis, awarded contract for grading and gravelling 12 miles Fed. Aid. Proj. 66, State Rd. No. 1, at about $85,000.

Mnn., St. Cloud—Reid & Yeager, local, awarded general contract for grading 24th avenue at $2,000; grading 8th street at $1,059; General Contracting Co., 1254 Plymouth Bldg., Minneapolis, contract for paving at $121,609.

Mo., St. Joseph—Metropolitan Paving Co., St. Joseph, awarded contract for paving practically all the streets of Marysville, Kans., (70 blocks) at total of $360,000.

Mo., St. Louis—Granite Bituminous Paving Co., Railway Exchange Bldg., awarded contract by Bd. of Public Service for paving on Taska street and Brannon avenue at $16,379 and $29,941, respectively. Also J. F. McMahon Construction Co., Title Guarantee Bldg., for paving on Lombard street at $10,330.

Mont., Great Falls—Birch & Son awarded contract for paving (Bithu.) First and Second avenues, at $152,040.

Mont., Helena—State Hwy. Com. awarded following contracts on Fed. Aid projects in Carbon County and Cascade County: 4 miles road and river protection to Carlson Contracting Co., at $27,000; Sun River project to White, Brown and Leahy—19 miles—at $85,000.

Neb., Lincoln—Hugh Murphy, Omaha, awarded contract for concrete road between Fremont and Ames—about 6 miles—at approx. $200,000. Road will be 18 ft. wide and built of gravel.

Neb., Laurel—Western States Constr. Co., Omaha, awarded contract for 20,000 yds. paving at cost approx. $82,000. Vitr. brick blk. will be used.

N. J., North Bergen—J. Devlin, 117 24th St., Guttenberg, awarded contract for repairing 34th and 35th streets, granite blk., at about $100,000.

N. J., Hackensack—J. E. Douden, N. Y. City, awarded contract for improving 4.63 miles Paterson Plank Road, at about $150,000.

N. J., Union—The Clinton Contracting Co., of West Hoboken, awarded the contract for paving the boulevard between Hackensack and Paterson Plank roads, North Bergen, by the Boulevard Board, at about $135,000.

N. M., Gallup—S. P. Gilles Construction Co., Arizona, awarded contract by city for 15,000 sq. yds. conc. pavement, at about $68,400.

N. Y., Brooklyn—Following contracts let by E. Riegelmann, Boro. Pres.: regulating, grading 39th street, to C. A. Meyers, at $2,040; W. 11th street to Annarock Eng. Co., at $2,695; 87th street to L. Mangerie, $3,331; 39th, President and Woodbine streets and Snediker avenue to Sicilian Aspnalt Paving Co., 61 Park Row, N. Y. City, at $8,071, $20,803, $9,782 and $8,548, respectively; Washington street to Leonard Paving Co., 233 Bway., N. Y. City, at $48,597; Ocean avenue to J. Ryan, $6,225.

N. Y., Cohoes—Warren Bros., Boston, Mass., awarded contract for paving South Saratoga street at $87,622 and Bevan street at $15,026.

N. Y., Long Isl. City—Contracts let as follows for regulating and repaving with sheet asph, Edison Pl., Trowbridge and Silver streets: Uvalde Asphalt Co., 1 Bway., N. Y. City, $7,471, $7,185 and $7,675, respectively; Lotus avenue to Sicilian Asph. Paving Co., 41 Park Row, N. Y. City, $15,899, Summerfield street, Hastings Paving Co., 25 Broad street, N. Y. City, at $41,795; 109th street to R. A. Hess, $2,291; Queens Rd. to Welsch Bros., $11,245, Edison Pl. C. A. Meyers, $1,443; 13th & Main streets to Peace Bros., 20 Main street, Flushing, at $37,652 and $21,681, respectively; Jackson avenue—Brdg. Plaza to Thompson avenue, Jackson avenue—Bridge Place to 2nd avenue, and Jackson avenue—2nd to Old Newton Rd., to F. J. Mason, at $20,700, $17,860 and $60,040, respectively.

N. Y., Rome—Bd. Pub. Wks. let contract to Warren Bros. Co. for paving Bloomfield street, at $8,621; Jay street, $7,735; William street, $7,735; Court Street, $3,141, and Court street—Kossuth to Bridge streets—at $3,307; Ridge street, $6,973; Elm street, $11,164.

N. Y., Salamanca — Morgan & Bock, Olean, awarded contract for paving Kent and Front avenues, High, Washington and Linden streets, at about $90,000.

N. Y., Seneca—Village will pave Clinton street and several others, concrete, by day labor. About $65,000.

N. Y., Syracuse—T. B. Wheeler awarded contract for resurfacing Cortland and South avenues, also Grape and So. West streets, at $65,359.

N. Y., Syracuse—G. B. Dickison, Union Bldg., awarded contract for paving City Hall Sql., and continguous streets, wood blk., at $73,651.

N. C., Fayetteville—American Contracting Co., Moultrie, Ga., awarded contract for paving Person street with sheet asph. at about $75,000.

N. C., Greensboro—L. A. Crawford & S. B. Crawford, Mebane, N. C., awarded contract for 17 miles sand-clay road at $35,000.

O., Ashtabula—McCutcheon & Company, Plains, Pa., awarded the contract for the construction of road between St. Clair and Frackville at $320,000.

O., Canton—Following contracts awarded for paving: Harry Coral, contract for paving Navarre Rd., SW., at $28,353; Wise Bros., Herbruck Ct. NE., at $5,315; Burd Constr. Co., Canton, Carnahan Ave., NE., and 11th Ave., NE., at approx. $82,319; F. A. Downs Constr. Co., Canton, contract for Fourth St., NW., at $43,549.

O., Cincinnati — Henkel and Sullivan awarded contract by county commrs. for building Carthage-Hamilton road from De Campe Ave. to the south corporation line of Wyoming with brick at $106,022.

O., Columbus—Andrews Asphalt Paving Co. awarded contracts for street paving at $122,772. Firm is located in Hamilton.

O., Dayton—Victor Wroe, local, awarded contract for paving Pyrmont street, Brookville, with asph., at $27,595.

O., Findlay—W. E. Dorsey awarded contract for constr. of 6 miles of brick roadway between Findlay and Fostoria, at $237,419.

O., Hamilton—Andrews Asphalt Paving Co. awarded contract for paving Laurel evenue, Benninghofen avenue and Bell avenue, at $66,000.

O., Toledo—Russell & Jennison Co., 2463 Broadway, awarded contract for repaving a section of Bancroft street at $32,768.

O., Toledo—M. P. Hannin awarded 3 road construction contracts by the county commrs. at about $170,000.

Okla., Paula Valley—Russ L. Mitchell awarded contract for 34,000 yds. paving at $132,000.

Pa., Beaver—Aaronsburg and McDonald Co., Norfolk, Va., awarded contract for building 14,481 ft. of road in Eastvale borough and North Sewickley Twp. at $138,431. Same company has contract for paving on Lawrence and Jefferson County roads.

Pa., Franklin — C. F. Hamilton, local, awarded contract for building river road from city line to new section near Reno at $131,698.

Pa., Harrisburg—M. Stipp & Son, 435 Moir Court, Scranton, awarded contract by State Hwy. Dept., for building 30,335 lin. feet rein. conc. rdway., N. Milford and Bridgewater Twps., Susquehanna Co., at $223,673.

Pa., Harrisburg — Edward J. Corcoran, Plains, Pa., awarded contr. by state hwy. commr., L. S. Sadler, to build $2,435 ft. of one-course reinforced concrete roadway on state highway route 161 in Schuylkill county at $324,590.

Pa., Harrisburg — Doller &, Anderson, Clearfield, Pa., awarded contr. by state highway commr. to build 17,977 ft. of one course reinforced concrete pavement on route 59 in Lawrence and Pike Twps., Clearfield Co., at $195,585.

Pa., Harrisburg—State Hwy. Dept. let following contracts for road construction: Beaver county, Eastvale Boro. & N. Sewickley Twps., 14,481 ft. rein. conc. construction to Aaronberg & McDonald, Norfolk, Va., at $138,431; Jefferson Co., Pine Creek Twp., 26,383 ft. one-course rein. concrete constr., on State Hwy. Route 60, to same contractor at $237,516; Lawrence Co., Union & Mahoning Twps., State Hwy., Route 61, 29,627 ft. constr., to same contractor at $242,816; Lycoming Co., Piatt and Porter Twps., 14,286 ft. constr., to W. J. Gephart, Pittsburgh, at $126,271; Northampton Co., Wind Gap to Stockertown, 29,182 ft. constr., to E. P. Arbogast, Stroudsburg, at $217,812.

Pa., Harrisburg—Following contracts let by State Hwy Department: Chester & Delaware Cos., 46,815 ft. bitum. mixt., on broken stone base—resurfacing, to Cunningham Paving & Constr. Co., Philadelphia, at $99,247.80; Montgomery Co., E. Norristown Twp., 5,575 ft., conc. constr., to Field, Barker & Underwood, Philadelphia, at $35,100; Springfield, Whitemarsh, Upper Dublin and Lower Cynwyd Twps., 37,723 ft., constr. to Mainwaring & Cummings, Philadelphia, at $242,302; Montgomery and Buck Cos., 15,898 ft. constr., to Henry E. Daton, Philadelphia, at $126,333.

Pa., Pittsburgh—Following contracts let for road impvt.: Thompson Run Road extension No. 2, Ross & McCandless Twps., one mile in length and 16 ft. wide, bitum. macadam surf., let to Thomas Cronin Co., at $58,047; Elizabeth Rd., Merkat St., Elizabeth to Monongahela City Rd. Forward Twp.—abt. 2¼ miles, 18 ft. wide, asph. conc., let to M. O'Herron Co., at $69,116; Troy Hill Rd., Reserve Twp., 2,000 ft. long and 16 ft. wide, Telford macadam, to Thos. Cronin Co., at 15,408; Connery & Co., contr. for 12 asph. heating kettles at $1,176, etc.

Pa., Palmerton—S. L. Cyphers, So. Bethlehem, awarded contract for improving Delaware Ave., with rein. conc. and slag sub-base, at $109,153.

R. I. Providence—Amos D. Bridges Sons, Inc., Hazardsville, Conn., award. contr. by the State Bd. of Rds., for reconstr. the Boston Post Rd. at Westly and Charlestown, at $104,416. Bituminous concrete will be used in resurfacing. Work to begin at once.

S. C. Abbeville—South Paving & Constr. Co., award. contract for constr. of paved streets here at $180,000.

Tenn., Maryville—R. L. Peters, Knoxville, awarded contr. by Blount Co. Comrs. for 73.6 miles grading and 68.8 miles of macadam at $400,000.

Texas, Brownwood—Smith & Helms, of Temple, awarded contract for constr. of the Oil Belt Hwy., through the Blanket precinct, at $87,791.

Texas, Canton—Dan La Roe, Palestine, Texas, awarded contr. by Van Zandt Co. Commrs., for grading, surfacing and draining 9.88 miles of state highway No. 15 at $114,830.

Utah, Bingham City—Gibbons & Reed, award. contr. for laying 4-in. crushed base with 2-in. bithu. top for paving 5 blocks of city streets, at $131,300.

Wash., Aberdeen—Aberdeen Paving Co., award. contract for paving—Elm to Satsop—at $188,690; Grays Harbor Constr. Co., Hoquiam, contr. for paving stretch of 3 miles—Hoquiam n. w., on north beach road.

Wash., Charleston—Contractor Stevenson has been awarded additional paving contrs. by the city council at about $100,000.

Wash., Seattle—G. A. Ferguson, 628 11th Ave., No., award. contract for surfacing

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Wash., Seattle—Hanson & Hauge, award. contract by Bd. King County Commrs., for grading and graveling Bellevue-Newport Rd.—3½ miles in length—including constr. of a 250-ft. trestle roadway, at $76,800.

Wash., Vancouver—Warren Constr. Co., awarded contr. for impvt. of 22d St.—Main to Reserve—by hard surfaced pavement at $29,617.

W. Va., Fayetteville—Shipe & Thompson, Barboursville, W. Va., award. contr. for grading 1 section of county hwy—approx. 3 miles—at $40,580.

W. Va., Windfield—Keeley Constr. Co., Clarksburg, W. Va., awarded contract by Putnam county for 40,000 sq. yds. graded earth road at $150,000.

Wis., Appleton—Johnson & Drake, 905 Plymouth Bldg., Minneapolis, Minn., award. the contr. for paving Mill St., Dakota Ave. and Pleasant St., with 7½ in. of concrete at $85,000.

SEWERAGE AND SEWAGE TREATMENT.

Cal., Los Angeles—Blaz D. Zaich, award. contract for constructing cement pipe sewer in Sanborn Ave.—Hoover St., to Del. Man Ave.—at $6,994; also cement pipe sewer in Virgil Ave.—Santa Monica Blvd. to Fountain Ave., at $3,840.

Conn., Portland—Salvatore Mazzotta, of Middletown, awarded contract for building sewer, at $45,560.

Conn., Stratford — (Bridgeport, P. O.)—Eastern Eng. & Constr. Co., 886 Main St., Bridgeport, awarded contract for bldg. sewage disp. plant, chlorine treat. house and tidal basin, and sludge bed, including piping and grading, etc., at $175,000.

Ill., Chicago—Louis Scully awarded contract by bd. of local improvements to construct tile pipe sewer with brick manholes and catch-basins in Maryland Ave., from East 81st St.

Ill., Chicago—Following contracts let for drains in various streets and avenues: Louis Scully. Work covered by 3 Warrant Nos.; Jno. Tiritilli, 1 W. No.; Angelo Mancini, 1 W. No.; Nascenzo Di Domenico, 1 W. No.; Graciomo Sironi, 1 W. Nos. (sys. of streets).

Ill., Chicago — The Ryan Co., awarded contract for Crawford Avenue system of sewers.

Ill., Chicago—Giacomo Sironi, award. a contract for drains in N. Kolmar Ave.—W. North Ave. to C. M. & St. Paul R. R.

Ill., Carlinville—Harry Arnold & Co., awarded contr. by board of local improvements for constructing the Plum Street Combination Sewer No. 1, at $1,465. Work will begin at once.

Ill., Rockford—Nick Santucci, Chicago, awarded contr. by board of local improvements, for sewer impvt., in Block No. 8, at $1,892.

Ill., St. Louis—Hall Constr. Co., E. St. Louis, award. contract for constr. of south end sewer, at $27,863.

Ind., Bloomington—Bloomington Stone & Construction Co., award. contract to construct sewers on E. 10th St., Cottage Grove Ave., and So. Rogers St. Company bonded to amt. of $6,300.

Ind., East Chicago—Campbell Construction Co., awarded contr. by board of public works, for construction of local sewers on Exchange and Short Aves.

Ind., Goshen — Wm. J. Law, awarded contracts by Nappannee town board for constr. of Highland sewer at $3,782 and Stauffer sewer at $795.

Ind., Indianapolis—Wm. Graves Co., 701 Tacoma Bldg., award. contr. for constructing Div. No. 1 of Sewage Disposal Plant for Sanitary Dist., at $321,475.

Ind., Muncie—Following contracts let for sewer construction in city: Shipley Ave.—Willard street south to 6th street, to Wm. Birch & Co., at $2.275 per lin. ft.; sewer in alley betw. Macedonia and Shipley Sts., to Jos. E. Davis, $1.67 per lin. ft.; in Beason street—First street so. to 1st alley no. of Willard street, at $2.50 per lin ft.

Ind., Wabash—Geo. C. Hipskind, award. contract for laying sewer on N. Miami St., from point 67 ft. n. of Gladstone street to northern extremity of Charley Creek, at $5,431.

Ia., Cedar Rapids—John C. Anderson, local, awarded the contract to lay 86,000 ft. of sewer in the road north of Marion, and will begin work at once.

Ia., Cedar Falls—Dearborn Constr. Co., 229½ West 4th Waterloo, Ia., award. contr. for sewers at $1,890 and water mains at $978; total, $2,868.

Ia., Charles City—Chris. Hansen, award. contr. for bldg. large number of storm sewer, at $79,925.

Ia., Coon Rapids—Dearborn Constr. Co., Waterloo, awarded contract for sewer system. Disposal plant will cost $16,000; the sewer, $61,614.

Ia., Kanawha—J. M. Lewis, Sioux City, awarded contract for bldg. sanitary city sewer for Aurelia, at $27,793.

Ia., Osage—Woolrich Constr. Co., Minneapolis, Minn., awarded contr. for constr.

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of sewage disposal plant at $38,653. Work will begin at once.

Ia., Pomeroy—W. B. Carter, Sioux City, award. contract for main and lateral sewers here at $28,075; Rude & Wold, Pomeroy, award. contr. for disposal plant at $17,690.

Ia., What Cheer—M. Elligot, Evanston, Ill., awarded contract for installation of complete sewer system to be finished by first of year, at something over $80,000.

Kans., Potwin—C. C. Jamison, El Dorado, awarded contract for sanitary sewer system, septic tank, at $25,000.

Mich., Alpha—City will expend $50,000 for sewer construction work, which will be done by day labor. S. A. Greeely, 39 West Adams St., Chicago, Engr.

Mich., Detroit—The following contracts awarded for bldg lateral sewers: C. Melevin, Penobscot Bldg., city, No. 3131, at $1,-895; Walker & Teetaert Co., 442 St. Clair St., Nos. 3140, $26,660 and 3164, $21,425, 3068, $29,566; Charlevoix Ave. sewer arm, $11,830; Lennane & McInvenna, Book bldg., Nos. 3153, $10,000; 3156, $8,950; Western Constr. Co., 1208 Ford Bldg., Nos. 3160, $7,-429, 3161, $9,217; 3167, $12,465, 3168, $8,949, 3160, $8,216; O'Rourke Eng. & Constr. Co., 17 Battery Pl., N. Y. City, Joy Rd. pub. sewer, conc., $988,218; Gawne Contg. Co., Cleveland, Linwood Ave. Pub. sewer, sect. 3, $136,506; Lynch Rd. Pub. sewer, sect. 5, $146,399; J. Winterbottom, 3274 W. 25th St., Cleveland, Lynch Rd. pub. sewer, sect. 6, conc. $112,378.

Mich., Grand Rapids—Vander Weele Bros. awarded contract for construction of a sewer in Fulton St., at $4,947.

Mich., Pontiac—E. Nenkoff, awarded contract for Roselawn-Fiddix sewer job at following prices: sanitary sewer in Roselawn Drive—end of present sewer to Fiddis and 10,755 ft. so. of Fiddis; also in Fiddis from Roselawn Drive 115 ft. westerly at $1.50 ft. 8-in. pipe, $1.10 for 6-in. $105 for manholes and $10 for lamp holes.

Minn., Alexandria—J. M. Renner, local, award. contr. for sewer constr. on 6th Ave. —K to N street, at 94c per ft., $1.50 for Y's and $50 for manholes.

Minn., Austin—De Graff Wolff, 985 Schafer, St. Paul, award. contr. for storm sewers, at $12,366.

Minn., Caledonia—Jasperson & Hosfield, Owatonna, Minn., awarded contr. for lateral sewers at $4,924.

Minn., Faribault—Following contracts for constr. of storm sewers let: Division St. storm sewer to Wm. Meyers & Co., Faribault, at $23,141; Seventh St. storm sewer to R. R. Thomas, Faribault, at $8,098 and Second Ave. sewer at $8,934; Fourth St. storm sewer to P. J. Gallagher, Faribault, at $9,314.

Minn., Hendricks—Coolsact Bros. & Dress, Marshall, Minn., awarded contr. for installing collection and disposal works at $36,668.

Minn., Mankato—F. A. Webster, Webster Constr. Co., St. Paul, award. contract for constr. of sewer system in N. Mankato, at $51,000.

Minn., Milaca—O'Neil & Preston, St. Paul, award. contr. by village to install sewer in Dist. No. 2, at $9,400.

Minn., Moose Lake—Range Constr. Co., Virginia, award. contr. for 2,060 lin. ft. 12-in. sewer; 1,300 lin. ft. 10-in., also 17 manholes.

Minn., Virginia—C. Christopherson & Co., local, award. contract for storm sewers on north side, at $3,943.

Mo., Kansas City—Thomas Kelly & Sons, Ltd., Winnipeg, Canada, awarded contract by Bd. of Pub. Work, for construction of the Turkey Creek sewer at $2,453,760.

Mont., Butte—G. L. Gagnon, 41-42 Owsley Bldg., city, award. contr. for putting in new sewer—400 ft. rein. storm sewer and 2 catch basins on N. Henry St., at $4,320.

Mont., Great Falls—Nilson & Smith, award. contr. for draining streets, laying storm sewers, at $14,482.

Mont, Livingston—McLaughlin & O'Neil, local, awarded contr. for constr. of Main sewer on Geyser St., at $6,000, main sewer from Park to Chinook Sts., at $5,000 and North Side sewer at $24,000. Same contrs. awarded contr. for pavement in alley between Main and Second Sts., at $9,800.

Neb., Deshler—Dennigan & Briggs, Shenandoah, award. contr. for sewers at $23,000.

Neb., Norfolk—Hanson & Wilardson Co., Omaha, Neb., awarded the contr. for sewer construction, at $33,074.

Neb., Osceola—Petersen & Schreiber, 213 Farnam Bldg., Omaha, awarded contr. for sewer construction, at $61,300.

Neb., Wayne—Katz Constr. Co., Omaha Neb., awarded the general contract for constructing storm water sewers.

N. J., Pleasantville—E. G. Britz, 1759 Park Ave., New York City, award. contract for bldg. 10 miles of sanitary sewerage system at $86,310.

N. Y., Garnersville—Linde & Griffith Co., foot of 4th Ave., Newark, N. J., award. contract for bldg. sewage disposal plant and water filter plant at about $45,000.

N. Y., Long Island City—Porter & De-Witt,, 6201 18th Ave., Brooklyn, awarded contract for bldg. sanitary and storm water sewers and appurts., in 32d Ave., Lawrence Ave., Willetts Point Blvd., and Linden St., at $659,218.

N. Y., Utica—Dominick Perritano, award. contract for construction of 16th Ward sewers, at $21,415; A. W. Fitch, award. contr. for new storm water sewer across property of J. F. Kelly, on Sunset Avenue running to West Shore R. R., at $483.65.

N. C., Warsaw—W. Z. Williams Co., awarded contract by city for constructing sanitary sewer system at $75,000.

O., Canton—Dominick Nickolas, award. contr. for constr. of sanitary storm water sewers in Cherry Ave., NE, Spring Ave., NE, 13th and 14th Sts., NE and Sherlock Ave., NE., at $6,895.

O., Chillicothe—Jardine Plumbing Co., award. contracts for sanitary sewers on Mulberry street and on Water street, at $1,692 and $4,726, respectively; Brewer & Brewer, award. contract for bldg. storm sewer on Western Ave.—Locust street and up through adjacent ravines, at $6,444.

O., Hamilton—Jno. L. Walker Co., city, award. contract for constructing sanitary sewer on N. 9th St., for Reservoir St., Booth Ave., Miami St., Stout St., Linn and Poplar Sts., at $9,715.

O., Springfield—City Manager O. E. Carr will construct by day labor the Edgewood sewer at estimated cost of $15,045.

O., Youngstown—Following contracts for sewer work let by Bd. of Control: Pearl Street sewer—Oak to Emma streets, to Pat J. Grady, at $1,206; Taylor street—Campbell to Shirley Rd., at $10,413, to Pat J. Grady; Almyra Ave., sewer—Glenwood avenue to Edwards street, to same contractor at $8,388, also Hartzell avenue sewer—Lakeview Ave. to city lot 425, at $2,160.

Okla., Idabel—The Empire Construction Co., awarded the contr. for the construction of sanitary sewerage system, at $119,-800.

Pa., Erie—Following contracts for sewer work in 6th and 5th Wards, let by Council: System No. 1, to Willis Bancroft, Jr., $24,918; Sys. No. 2, F. G. Diefendorf, $20,-047; Sys. No. 3, Proj. No. 1, to V. Calabrese, $9,282; Sys. No. 3, Proj. No. 2, F. G. Diefendorf, at $13,441; Sys. No. 3, Proj. No. 3, F. G. Diefendorf, at $2,897.

Pa., Erie—V. Calabrese, awarded contract for building storm water sewer in 8th and South streets, at $10,000; also for constructing a 9 in. sewer in 19th street at $1,842.

Pa., New Bethlehem—The Manella Construction Co. of Pittsburgh, awarded contract for constructing sewer into this city at $46,000.

Pa., Philadelphia—Contracts as follows for sewers: Jos. Lombardi, main sewer in Knox St., so. of Erdrick St., at $94,040; Jos. Peiria, main sewer on 69th St., at $45,-206; extension of Wingohocking sewer to J. Jos. McHugh, at $35,301; Emilio Pascuzzie, for extending Cobbs Creek sewer along 69th St.—Girard Ave. to Malvern St., at $69,967.

Pa., Westmont—Penn Corson, Camden, award. contract for constr. of 9-mile sanitary sewer system at $69,054.

R. I., Woonsocket—Camdella Co., Walford, Mass., award. contract for bldg. & furnishing material for 3,530 ft. 8-in., 1,-025 ft. 10-in. and 230 ft. 15-in. sanitary sewer and appurts., at $26,800.

S. D., Aberdeen—J. J. Dunnegan, Shenandoah, Ia., awarded contract for sewer construction at $442,228.

Tex., Dallas—W. H. Nichols, 116 W. 12th St., award. contract for 4,000 ft. 33-39 in. conc. and 18-21 in. tile sewers in Parry Ave. Dist., at $22,223.

Utah, Salt Lake—A. L. Griffiths, award. contr. for storm sewer and sidewalk in 13th So. Street—Fifth E. and State Sts., at $27,156.

Wis., Janesville—G. W. Mulholland, Rockford, Ill., award. contr. for bldg. sewers in Dists. 3, 4, 5, 10, 11, 12, 14, 15 and 16, at $31,375.

Wis., Jefferson—G. W. Leismann, Fort Atkinson, award. contract for laying sewer in Highland Park.

Wis., Kenosha—Christ Johnson, local, awarded contr. for constructing sewers on Corcorcan Drive and Fairview Ave., at $75,000.

Wis., Kewaunee—Gray-Robinson Co., Manitowoc, award. contract for construction of sewers on sects. of Center St., First, Ellis, no. to Harrisson, so. to Juneau and no. again to Miller St.; August Bohne, award, contract for putting in sewers on Main St.—present end of system to Kilbourne St., etc.

WATER SUPPLY AND PURIFICATION.

Ariz., Jerome—J. D. Newcomb, Jerome, award contr. for laying pipe for new line system in Jerome, at $13,600.

Cal., Mexicali—Henry Clark Co., 1101 E. 5th St., award. contr. for constr. of water works system for city, at about $200,000. Water will be taken from high-line canal at Seven-Foot Drop and work will include constr. of pipe lines, settling basins, a 2,-500,000-gal. storage tank, etc.

Cal., Santa Barbara—S. J. Krull, award. contr. to constr. trench for 24-in. pipe to be laid from so. portal Mission tunnel to Sheffield reservoir, at $3,145.

Ill., Chicago—Following contracts let for water service pipes in various streets and avenues: Daniel Hardin, work covered by 8 Warrant Nos. Fred Seip, 1 W. No. and David Walsh, 2 W. Nos.

Ill., Salem—W. C. Johnson Constr. Co., S. High St., Belleville, award. contract for bldg. rein-conc. brick and steel filtration plant, at about $12,000.

Ind., Whiting—C. W. Secord, West Pullman, Ill., award. contr. for bldg. 4,000,000-gal. capy. filtr. plant, including two 3,000,-000-gal. and two 5,000,000-gal. centrifugal pumps, at about $180,000.

Ia., Decorah—Moore Serg. Constr. Co., Waterloo, award. contr. for 12,000 ft. 4-in. water main at 80c a ft., making 18 connections to old main at $20 each, setting 16 fore hydrants at $15, etc., etc., total amt. of contract, $12,640.

Ia., Ladora—Pittsburgh-DesMoines Steel Co., awarded contr. for constructing water works system at $17,790.

Ia., Sioux City—Frank Leeder, award. contract for constr. of brick pumping station and 250,000-gal. reservoir in North Riverside, at $7,947.

Minn., Brainerd—General contracts for impvts. to water works sys., let to J. W. Hildred & Co., 33 E. 3d St., St. Paul, at $13,275; reservoir to Circular Conc. Co., 846 Builders Exch., Minneapolis, at $15,490; flanged fittings to U. S. Cast Iron Pipe & Foundry Co., 122 S. Michigan Ave., Chicago, at $3,775; valves to J. B. Clow & Sons, 544 S. Franklin St., Chicago, at $2,-257.

Minn., Duluth—Nordquist and Berg awarded contr. for laying water and gas mains on various streets at $6,434. Also to Johnson and Korhonen, for similar work at $7,737.

Minn., Hinckley—O'Neil & Preston, St. Paul, award. contr. for constr. of general sewer and water works, at $50,000.

Minn., Montevideo—Circular Concrete Co. Minneapolis, awarded contract to construct circular reservoir—400,000-gal. capy.—at $16,625; W. D. Lovell, Minneapolis, award. contract to install several thousand feet water mains and furnish necessary equipt. to complete job at $22,320 for the mains and $5,621 for pumps and machinery. Contract calls for 2,000 ft. water mains to be installed from pumping station to connect with the mains at the Chippewa Mill on First St., 740 ft. 6-in. pipe on Summit Ave. 450 ft. 6-in. on Merriam Ave., 1,600 ft. 6-in. on Gravel Rd. and 770 ft. on Fifth St., north.

Minn., New Prague—Des Moines Bridge & Iron Works, Tuttle bet. 9th and 11th Sts. Des Moines, awarded contract for 60,000-gal. hemispherical bottom for steel tank, at $62,000.

Mo., Mt. Vernon—Urbauer-Atwood Heating Co., 115 S. 11th St., St. Louis, award. contr. by Bd. of Mgrs., Missouri State Sanatorium, for bldg. water system, at $12,-975.

Mo., St. Louis—A. H. Haeselaer Bldg. & Contracting Co., Wainwright Bldg., award. contract by St. Louis Mfg. Co., 5325 Natural Bridge Rd., for skeleton water tower; conc. and brk. pumphouse and reservoir, $8,000.

Mont., Great Falls—Collins Plumbg. and Heating Co., award. contr. for water service installation at $3,250.

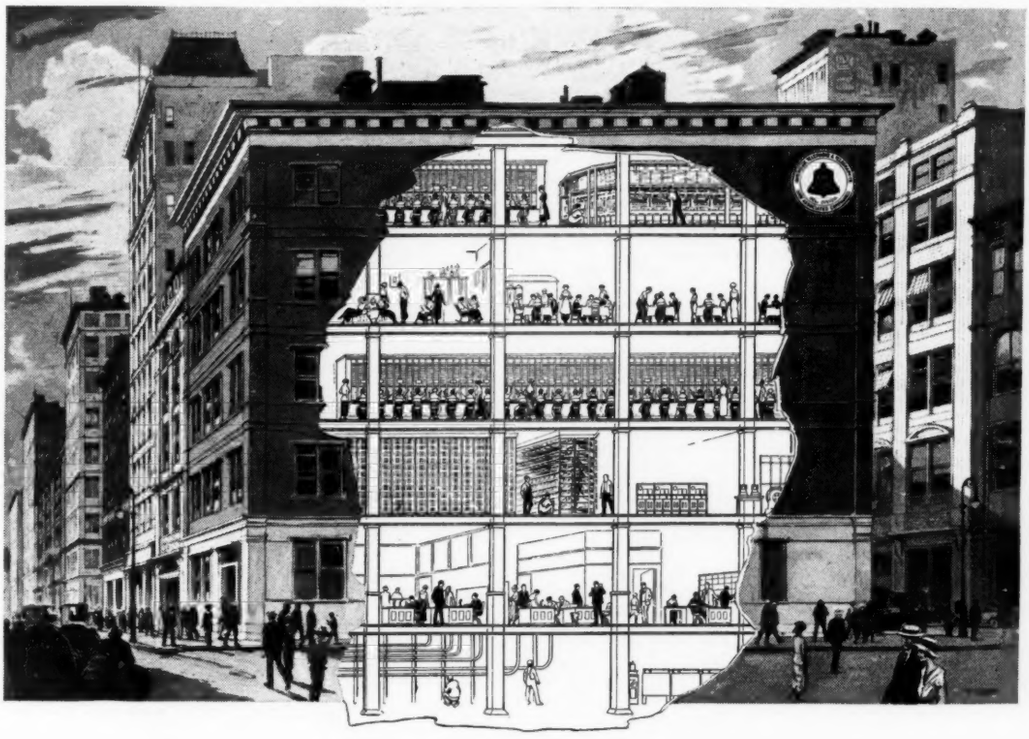
Mont., Scobey—Geo. W. Kemper, Minot, award. contract for installing the water and sewer systems here at $145,754.

Neb., Indianola—Katz Constr. Co., award. contract for new water system, at $31,522.

N. J., Jersey City—P. McGovern, 50 E. 42d St., N. Y. City, awarded contract for duplicating existing syphons betw. Passaic River at Lyndhurst and Summit Ave. reservoir, here, Sec. 2, of pipe line betw. Boonton Reservoir and here, at $2,056,619.

N. D., Edgeley—W. D. Lovell, Minneapolis, Minn., awarded contr. for installing water works system.

N. D., Fargo—Wm. E. Kennedy, award. general contract for main on 8th St., S., betw. 2d and 4th avenues and bet. 5th and 8th avenues at $6,698; Haggart Constr. Co., 60 Bway, Fargo, contr. for water mains on 2d ave., N. bet. 13th and 14th streets, at $2,686.



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O., Bycyrus—Bust Engineering Co. Pittsburgh, awarded contract at approx. $70,000 to construct additional reservoirs and clear wells.

Ohio, Dover—Philip Sheets, Newcomerstown, Ohio, will be awarded contr. for water pipe line extension on Wooster Ave. and 13th St.

O., Springfield—Doyle & Hanahan, 935 Avondale Ave., award. contract for bldg. 2,300 ft. 42-in. c. i. pipe to increase water supply, at $34,410.

Okla., Yale—Gudgel & McVey, Stillwater, awarded contract for constructing Yale water works system.

Pa., Philadelphia—W. Cramp & Sons' Ship & Engine Co., Richmond and Norris Sts., awarded contract for furnishing and delivering steel pump shaft at Torresdale Station, at $1,460; laying c. i. pipe lines to M. & J. B. McHugh, 829 N. Market St., at $36,860.

S. D., Wetonka—Kelley Plmg. & Htg. Co. Aberdeen, S. D., awarded contract for water works system. Reservoir, standpipe, pump and engine; approx. 10,000 ft. cast iron pipe, with hydrants and specials.

Utah, Price—Staes-Zeese & Raikes, awarded contract for furnishing labor for laying 24.5 miles pipe line from here to Calton, at $71,595.

W. Va., Farmersburg — Western Rivers Co., Point Pleasant, award. contr. for constructing a filter bed for city water works at $20,545.

Wis., Milwaukee — Allis-Chalmers Co., awarded contract for 20,000,000-gal. pumping engine for the No. Point pumping station, at $225,000.

Wis., Portage—Herman Kutske, Portage, award. contract for filtration plant.

BRIDGES AND BUILDINGS.

Ala., Birmingham—J. H. Scruggs Construction Co., awarded contract by Bd. of Revenue for building reinforced bridge 89 ft. long by 115 ft wide over the creek at Third avenue, at $23,500.

Fla., St. Augustine—Following contracts let for constr. of bridge over St. Johns river, Jacksonville to south side at total cost of $908,627; Bethlehem Bridge Corporation, material and approaches at $374,447.

Ga., Savannah—Beasley Contracting Co., will probably be awarded contract for steel spand and draw bridge across the Altamaha river at Sister's Bluff, according to announcement made by Altamaha River Bridge Company. Constr. involves approx. $125,000.

Ill., Chatsworth—H. I. Rodgers, Grand Ridge, contract for erection of Allen and Briner conc, bridges, Newton Twp., at $6,850; Joliet Bridge and Constr. Co., contract for Sterensberg bridge in Charlotte Twp. at $968.

Ill., Chicago—Standish & Allen, 220 S. State street, awarded contract by Forest Preserve District of Cook county, Cook county Bldg., for bldg. brdg. over Des Plaines river on Washington Blvd., at $58,985.

Ill., Decatur—Chas. H. Muirheid awarded contract for rein. conc. bridge (Stewart bridge) 3½ miles south of Argenta, at $3,1000; Birt & Driscoll contract for bridge 3 miles west and ¾ mile south of Warrensburg, at $1,946.

Ill., Fairbury—Following contracts let for erection of bridges: H. I. Rogers, Grand Ridge, awarded contracts for erection of Allen and Briner concrete bridges in Newton Twp., at $6,850; Joliet Brdg. & Constr. Co. contract for Sternberg bridge at $968.

Ill., Kankakee—The M. P. Company, awarded contract for constr. of what is known as the North river bridge of Ganeer and Momence Twps., at $28,789.

Ill., Springfield—The state highway department has awarded the contract for constructing bridge No. 96 in Iroquois Twp., Iroquois county, to the Centinental Bridge Co., at $2,855. Also to A. R. Smith & Co. for constructing the Eckley Bridge in West Jersey Twp., and the Keer Lick Bridge in Goshen Twp., Stark county, at $2,890 and $2,279, respectively. Also the Lelter Bridge in Denning Twp., Franklin county, to Parham Construction Co., at $3,469.

Ill., Springfield—Nelson Bros. awarded contract for Cummings and Timpe bridges, Mississippi Twp., Jersey county, at $1,730 and $1,322, respectively.

Ill., Springfiled—The James-Shinn Co. awarded the contract for constructing the Dan Lee, Joel Miller and Helmuth bridges between Douglas and Moultrie counties, at $9,270.

Ill., Springfield—Frank Ives awarded contract for White bridge in South Muddy Twp., Jasper county, at $4,110.

Ind., Indianapolis—Montgomery & Parker awarded contract for Honey creek bridge with span of 60 ft. and Blunt bridge, span 75ft., at $13,800.

Ind., Plymouth—National Conc. Co., Indianapolis, awarded contract for construction of conc. brdg. over Yellow river, at $64,857.

Ind., Rochester — Jas. Wadell, City, awarded contract for constructing new bridge on Otis L. Aller road and repair bridge on same road, at $34,873.

Ind., Rockport—The M. M. P. Contract Co., of Rockport, awarded a contract to build a reinforced concrete bridge 284 ft. long over the Kankakee river at Momence, Ill., at $30,000.

Ind., Shoals—Joel G. Jones, City, awarded contract for completing Butler bridge, at $5,500.

Ia., Atlantic—Wilson Concrete Co., Red Oak, Ia., awarded general contract for 25 concrete culverts and bridge abutments, at $3,764.

Ia., Cedar Rapids—The Koss Construction Co., of Des Moines, awarded the contract to construct a 6-span bridge across the Cedar river here, at $418,999. Bridge will be known as the First Avenue bridge.

Ia., Charlton — Pittsburgh-Des Moines Steel Co., 4th street south of Tuttle, Des Moines, awarded contract for brdg. work, at $14,500.

Ia., Eldora—Miller Fifield Construction Co. awarded bridge contracts by Bd. of Supervisors at $10,985; also the C. A. Holvik Co at $8,700; also the A. Olson Construction Co. at $10,968.

Ia., Humboldt—The Miller-Fifield Construction Co., Waterloo, Ia., awarded contract for constructing river bridge at $29,248.

Ia., Osage—A. Olson Constr. Co., Waterloo, Ia., awarded contract by Mitchell county for constructing 34 ft. concrete deck bridge at $4,597; one pony truss with concrete floor and abuts., 90 ft. span, at $10,330, and one bridge at Stacyville, at $12,100.

Ia., Sigourney—Jno. Ritzinger awarded contract for bridge work at a little over $28,000.

Ia., Sioux City—Clinton Bridge Co., Clinton, Ia., awarded contract by County Supervisors for constructing 21 small I-beam bridges and one 16x60 pony truss bridge at $14,200; also Pickins Engrg. Co. awarded contract for one 16x90 ft. pony truss bridge with concrete floor and abutment at $9,486.

Ky., Middlesboro—Lutin Bridge Co., Chicago, awarded contract for construction of concrete bridge across canal on 20th street at est. cost of $15,000.

Me., Augusta—State Highway Commission awarded the contract for the construction of the bridge across Cormier Brook in Grand Isle to the Selectmen of the town at $4,730; also across Pearce Brook on Green street in Houlton to G. W. Van Tasel of Houlton at $3,511; also the Gilman Falls bridge in Oldtown to Cyr. Bros. Co. of Waterville at $45,825.

Mich., Bessemer—R. L. Erickson, Bessemer, awarded general contract for bridge No. 103 at $6,230.

Mich., St. Ignace—A. S. Decker & Co., 1608 Beech street, Flint, awarded contract for bldg. 60 ft. bridge over Carp river, 18 ft. wide, Mackinac Co., at $28,556.

Mich., Lansing—Following contracts let for state trunk line bridges: No. 103, over Baltimore river, Standard Twp., Ontonagon Co., to R. L. Erickson, Bessemer, Mich., at $6,230; No. 204, over Grand river, Ionia Twp., Ionia Ca., to Benhagel Constr. Co., Ionia, Mich., at $3,239; No. 369, over Cedar river at Gladwin, Gladwin Co., to Ross & Williams, Beaverton, Minn., at $18,372; No. 112, over Carp river, St. Ignace Twp., Mackinac Co., to A. S. Decker, Flint, at $28,556; No. 292, over drain near Zeeland, to Peter Brill, Zeeland, at $3,110; No. 261, over Pigeon river, Wolverine Eng. Co., Mason, Mich., $11,970; No. 274, over drain near Zeeland, E. C. Nolan & Son, Edenville, $8,224; No. 201, over west branch of Sturgeon river, Hicks Eng. Co., Vulcan, Mich., $10,080; No. 150, over Ruch creek, H. A. & M. C. Nichols, Hastings, Mich., $8,500; No. 291, Brookville Brdg. Co., Brookville, O.

Minn., Duluth—County Board of Commrs. awarded bridge contract for total sum of $205,670. The following contractors were awarded important contracts: Aday & Maturi, Chisholm; Wausau Iron Works, Wausau, Wis.; Strom Brothers of Two Harbors, and Iowa Bridge Co., of Des Moines, Ia.

Minn., Pine River—Gervais & Rockeford, 1924 Fremont avenue, N., Minneapolis, awarded contract for bldg. bridge 3070 on Hwy. No. 24, 710 ft. long, at about $15,000.

Minn., Princeton—McCabe & McCabe, 602 Metropolitan Bank Bldg., Minneapolis, awarded contract for bridge across Rum river north of Princeton, at $7,500.

Mont., Helena—Following contracts let: Security Brdg. Co., Billings, Huntley brdg. over Yellowstone at $63,000; Toston brdg., $55,000; Buell Brdg. Co., Missoula, contract for Belle Crossing bridge, at $17,000; Crenshaw Co., Livingston, Carter brdg.; at $37,400; C. W. Ball, Forsythe rd. at $20,000.

Neb., Lincoln — Pioneer Constr. Co., Kansas City, Mo., awarded general contract by Lancaster Co., for constr. of 2 bridges (conc.) at $3,618 and $2,395, respectively.

N. M., Santa Fe—El Paso Bridge & Iron Co. awarded contract for Santa Cruz brdg. just out of Espauola, at $3,000.

N. D., Bismark—J. J. Rue, awarded general contract for 2 50-ft. conc. bridges in Cromwell Twp., at $9,400.

O., Akron—Concrete Constr. Co., Canton, awarded contract for bridge at Peninsula at $7,000; also repair work on Thorton St. bridge at $1,800; Humphrey & Hovey, City, contract for slab girder bridge over old Ohio Canal at $13,800.

O., Columbus—Cold Sheet Metal Wks., City, awarded contract for superstruct. for Hayden Run bridge, over Hayden Run, Norwich Twp., at $3,990.

O., Dayton—Contracts for construction of small county bridges awarded by county commrs. to D. F. Bowman, to Herman Behnken and to A. F. Weist.

Okla., Tulsa—Concrete, Steel & Constr. Co., Joplin, awarded contract for constr. of steel and conc. brdg. over Caney river at point east of Collinsville, at $28,250.

Pa., Apollo—Farris Eng. Co., Empire Bldg., Pittsburgh, awarded contract by Commrs., Armstrong and Westmoreland counties, to repair joint county bridge, at $15,274.

Pa., Harrisburg—Anthracite Bridge Co., Scranton, awarded contract for superstruct. for one triple span hwy. brdg., composed of 3 deck trusses each 135 ft. C to C, at $56,538. Located in Wyoming Co., Nicholson Boro. G. A. & F. M. Wagman, Dallastown, Pa., contract for one thru-truss hwy. bridge 138 ft. C to C, York Co., on State Hwy. Route 127, at $28,890.

Pa., Philadelphia — Charles P. Dower awarded contract for construction of two bridges on the northeast boulevard, at $187,664.

Pa., Summerville—Concrete Steel Co., Clarksburg, W. Va., awarded contract for bldg. rein. conc. brdg. at about $39,000.

S. D., Big Stone—Minneapolis Bridge Co., awarded contract for steel bridge on state road at $5,350.

S. D., Huron—Iowa Bridge Co., 717 McKnight Bldg., Minneapolis, awarded contract (general) for 15 bridges, at approx. $100,000.

S. D., Watertown—T. H. Pendergast Bridge Co. awarded contract for constr. of 6 bridges, form 16 to 48 span.

Tex., El Paso—El Paso Bridge & Iron Co., awarded contract for constr. of brdg. across the Santa Cruz river in Rio Arriba county, N. M., at $3,000.

Tex., Gilmer—Kansas City Bridge Bldg. Co., Kansas City, Mo., awarded contract for bridges in Upshur county, at $46,000.

Va., Norfolk—Chas. B. Cross awarded contract for restoring West Norfolk bridge, at $5,000.

Wash., Olympia—C. G. Huber, Seattle, awarded contract by Bd. Thurton Co. Commrs. for constr. of a $132,000 bridge on West Side. Bridge will be on conc. constr., with wooden approaches.

W. Va., Morgantown—B. M. Chaplin Co., Morgantown, awarded contract by Commrs. Monongalia Co. for bldg. two conc. bridges at $15,224.

Wis., Hartford—Joseph Schneider Constructing Co., Menasha, Wis., awarded contract for constructing concrete bridge over Milwaukee river at West Bend, at $17,860.

Wis., Madison—Following contracts let for bridges: Erfurth bridge to W. E. Gifford, Madison, at $4,850; Edseth bridge, Swenson & Dunlap, Mt. Horeb, $1,886, and Randall bridge, at $1,288; Francis bridge, to R. H. Peterson, Oregon, at $7,250, and Story bridge, $2,150; Nelson bridge, $756, Culvert bridge, $420, Voleker bridg. to Chas Klein, Sun Prairie, $1,703; Gerville bridge to R. H. Peterson, Oregon, $4,150; Carter bridge to L. C. Christenson, Cambridge, $4,325; and Rorge bridge held for consideration.

Wis., West Bend—The Joseph Schneider Contr. Co., Milwaukee, Wis., awarded the contract by the common council for buildg. a concrete bridge on Division street, at $17,860.

PROSPECTIVE WORK

ROADS AND STREETS.

Ala., Birmingham—Orders calling for paving on various streets adopted by City Comn. Est. cost of work, $15,000. This includes $10,000 for improvement of Pike avenue in Emsley.

Ala., Dothan—Ord. passed by council to pave residence sects. of W. Main, N. Oates and N. Foster streets.

Ala., Montgomery—W. S. Keller, State Hwy. Engr.; 2,500 mile road being considered; vote on $25,000,000 bonds.

Ark., Humphreys — City council has passed an ordinance providing for the paving of about 10 blocks on Main and Mulberry streets.

Cal., Fresno—County Engr. Chris Jensen announces that plans for abt. 50 miles of conc. rds. to be built under the 4,800,000 bond issue, have been completed. Bids will be asked in near future—as soon as the specfs. have been prepared which will be some time in September.

Cal., San Francisco—Brussells street—Bacon to Woolsey streets — has been ordered improved by grading and constr. of curbs, walks, catchbasins and asph. pavement.

Cal., Springville—Rd. from Springville to Camp Nelson—16 miles north—will be built jointly by the U. S. forest service, Tulare county and the Southern California Edison Co., each contributing $27,000 to cost. Forest service desires to extend road 20 miles farther to the Kern Lake Dist. and Edison Co. will probably co-operate in the extension.

Conn., New Haven — Town of North Haven has voted to ask state for appropriation of $20,000 for repair and bldg. of hwys. in town; Willington, $20,000 appropriated for good road construction; Hartford, East Windsor voters authorize selectmen to seek grant for improving Broad Brook-Windsorville road. Will apply to state for $20,000 appropriation.

Ct., Danbury—Bd. of Aldermen passed resolution approving special appropriation of $150,877 for repaving of streets in business section of city and to cover other expenses.

Ct., Danbury—Appropriation of $5,236 made for widening west side Main street, repaving Main, White, Elm, River Rose streets, $100,000; repaving portions trks. of D. & B. St. Ry. Co., on above named streets, $27,733.

Ct., Torrington—Vote passed at special meeting to appropriate $20,000 for work on roads.

Ct., Windsor Locks—Plans being prepared for new concrete road on Main street by engineers of State Highway Department.

Fla., Tallahassee—$4,932,000 apportioned from Federal and State aid to complete main trunk highways; includes road No. 1—Pensacola to Jacksonville; No. 2—Georgia state line to Fort Myers, through Hamilton, De Soto and other counties; No. 3—St. Johns River through Putman, Seminole and Volusia counties; No. 4—Georgia state line to Miami; No. 5—High Springs to Sarasota.

Ga., Augusta—Ord. to be introduced to pave one mile stretch of gravel street from intersection of Twiggs and Twelfth streets to beginning of county road pavement on Savannah road near Turpin Hill.

Ida., Boise—Contracts amounting to $1,600,000 will be let on the north and south highway of Idaho within next 30 days. W. J. [illegible] Commr. of Public Works.

Ida., Lewiston—Hard surfaced highway to be constructed along Clearwater river. Road will run from Ahsahka to Arrow and connect with Lewis and Clark hwy., soon to be surveyed along the Clearwater. Work on new road will begin in the early fall. According to present plans hwy. will be surfaced with macadam.

Ill., Belleville—Property owners are coming in with petitions that alleys be paved by special assessment. South Charles street will be paved from Freeburg avenue to the city limits.

Ill., Blue Island—Ord. passed to improve streets on east side. Est. cost, $159,979. Tarvia will be used for the paving. Citizens on the south side of the city have signed a petition for same impvts., as have been granted the east side. Petition accepted and referred to Bd. of Local Improvements.

Ill., East St. Louis—Ard. adopted providing for repaving St. Louis avenue—Collinsville avenue to 10th street—with asph. According to est. of city engr. work, including cost of making assessment and legal expenses will amount to $53,880. Plan is to remove present brick and relay street with concrete. New curbing also provided for.

Ill., Carlinville—Bd. of Local Impvts. has decided to proceed with following improvements as far as possible. Ords. will be presented to council: Paving First North street, section from C. & A. Ry. east to blk east of College avenue. Est. cost $40,000; sect. of Daley street, McDaniel street; also constr. of 12-in. sewer from W. Main through addition to Nicholas. Est. cost of sewere wk., $2,800.

Ill., Decatur—Property owners of Highlawns addition have petitioned city council for street paving. Council has passed ordinance to pave West Grand avenue, at cost of $46,810.

Ill., Joliet—Council contemplates paving Madison street—11th to 14th streets.

Ill., Joliet—City contemplates paving of Ruby and Broadway streets. Est. cost, $250,000. Ruby street project will cost $94,977; Broadway, $131,151.

Ill., Lovington—City will make following improvements: Beginning at intersection of State and Bway., north on Bway, to 130 ft. north of north line of William St., water main will be laid and in other streets 24-ft. paving will be laid.

Ill., Ottawa—Bd. Local Impvts. have planned to pave the 28 blocks being considered for impvt. in Mendota, with concrete. Est. price, $2.42 for concrete.

Ill., Peoria—R. H. Radley, Corp. Counsel for city, has filed petition with county court for impvt. of First Ave.—Franklin to Spencer Sts. It is proposed to resurface this thoroughfare with asph. concrete. Ord. passed by Council. Est. cost of improvement, $15,281.

Ill., Quincy—Work of bldg. West. Quincy-Taylor hard rd. will probably start this month. Just as soon as survey is made by Co. Engr. Ely, Marion Co., work will commence.

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Ill., Springfield—State Hwy. Comn. has ordered a survey made of the Peoria-Quincy road by way of Canton, Lewistown, Bushville, Mt. Sterling, connecting county seats of Fulton, Schuyler, Brown and Adams Cos., with hard surfaced road built by state under the sixty million dollar bond issue.

Ill., Springfield — Construction of road from Quincy to Danville through Springfield, is being considered.

Ill., Waukegan—Bd. local improvements has decided to pave four more streets; rein. conc. Pavement will be 25 ft. wide, 6 ins. thick at curb and 9 in center. Approx. cost, $50,000.

Ind., Gary—Resurfacing of Virginia St., Fifth ave. to the Wabash tracks, is next big street impvt. job to be taken up by city engrs. and bd. of works. Est. cost of work, $40,000. Other work planned and which will be started this summer is: Impvt. of McKinley street—15th Ave., to 19th ave.; Madison St.—25th to 27th Sts., est. cost, $9,500.

Ind., New Albany—Plans and specfs. submitted to Bd. County Commrs. by Michael Bolin, Co. Engr. for River Rd., New Albany Twp., Georgetown Rd. No. 3, in Georgetown, and Scottsville Rd. in Lafayette Twp.

Ind., Princeton—County will vote Sept. 27, on issuance of road and bridge bonds in the sum of $300,000.

Ind., South Bend—$200,000 bond issue for constructing Edwardsburg Road from South Bend to county line, authorized by St. Joseph Council.

Ind., Terre Haute—County Commrs. are planning to issue $56,000 in bonds to pave the Overpeck Road in Otter Creek Twp.

Ia., Afton—Woodbury County has voted to hard-surface primary road system and issue $2,500,000 bonds for this purpose.

Ia., Council Bluffs—Paving of S. 6th street—16th Ave. to 26th Ave—has been ordered by City Council; also paving of entire length of Ave. B.

Ia., LeMars—By a vote of nearly 2 to 1, Plymouth County voted for paved roads.

Ia., Rock Rapids—At special election, Lyon Co., $1,125,000 road bonds were carried. E. J. Riegel, Aud.

Kans., Ellinwood — City Council has passed resolutions for paving in both the residential and business sections.

Kans., Emporia—City Council contemplates paving 3 blocks on 6th Ave., between Chestnut and Lincoln Sts.

Kans., Minneapolis—Co. Commrs. have declared route of the old Meridian road south of town to county line, a public utility. Have asked for federal aid on this project.

Ky., Mt. Sterling—City Council passed ordinance for paving several streets with asphalt.

Kans., Salina—Co. Surveyors have begun survey of Golden Belt Rd.—Salina to Solomon and Meridian Rd.—Intersection of Bee Line to county line. Surveys being made, preparatory to hard surfacing.

Ky., Madisonville—Plans complete in abt. 6 weeks for last two-mile extension of Calhoun - Madisonville state aid road by High Crozier, Div. Engr.

La., New Orleans—City considering paving streets in wholesole section; program involving expendt. of approx. $1,000,000, practically completed by Commr. Stone and Association of Commerce.

Mass., Charlton—Bids may be asked within the near future for constr. of concrete road through Charlton City, as part of state hwy. betw. Worcester and Southbridge—about one mile in length. Edw. A. Lamb, chairman of selectmen.

Mass., Newton—Upon recommendation of Street Dept. at City Hall, West Newton, appropriation of $45,000 for constr. of Dudley road, given favorable action.

Mich., Cassopolis—Petition filed with Highway Department for constr. of concrete road from Niles past the new Michigan Central Terminal being built in Howard Twp. Road would be 2 miles long.

Mich., Muskegon—Property owners have filed petition asking that 30-ft. concrete pavement be built on Davis St. Lake to Palmer; Palmer St, Davis to Vanderlinde Sts. Supplementary petition also asks that a double drive be constructed on Palmer street—Davis to McGraft Sts., along blvd. lines with park in center. Petition also received asking that Elizabeth street and the Grand Rapids road be paved with crushed stone from Wood and Getty avenues.

Minn., Alexandria—City will pave Main street and 5th avenue—abt. 14 blocks in Spring. H. S. Campbell, city clk.

Minn., St. Cloud—Plans and specfs. for grading 24th Ave., north from Third St., to Cooper Ave., will be prepared by city engr.

Minn., St. Paul—Council passed final order for grading Margaret Street—White Bear to Ruth Aves. Est. cost, $15,426.

Minn., Minneapolis — The City Council has tentatively ordered $1,500,000 worth of paving for the year 1920.

Minn., Stillwater—County Commrs. will be petitioned to bond the county for $250,000 for building 10 miles of concrete road from city to Ramsey county line.

Mo., Kansas City—Resolutions adopted by Bd. Pub. Wks. for grading Washington Park Blvd., from point just east of the Blue River to eastern city limits.

Mo., LaGrange—At special election the $50,000 bond issue for hard road construction in LaGrange Special Road District, carried by a vote of 10 to 1.

Mo., Platte City—Commrs. Platte county considering paving and grading 38 miles of roads. Leslie-Barns Engrg. Co., American Natl. Bank Bldg., St. Joseph, Mo., Engrs.

Mo., St. Joseph—Board of Pub. Works has decided to ask bids for resurfacing 7th St.—Edmond to Olive—with asph. concrete, Third St.—Isabelle to Albemarle—with asphalt layer over old brick; repaving 2nd St.—Felix to Charles—with brk. blks. and Duncan St.—26th to 28th, with asphalt concrete.

Mont., Billings—F. H. Calkins, Forest Hwy. Engr. will make survey for road from Red Lodge to head of west fork of Rock Creek in Beartook forest.

Mont., Helena—City contemplates paving various streets with concrete or bithulithic. J. McLeod, City Engr. Abt. $150,000.

Neb., Fullerton—Preparations are being made for the laying of 25 blocks of pavement.

Neb., Wahoo—The preliminary work on the streets in preparation for the paving of 40 blocks is nearly completed.

N. J., New Brunswick — Sts. and Rds. Comm. of Boro. Council, Highland Park, introduced at recent meeting an Ord. for paving of 5 streets which will involve expenditure of $146,000.

N. Y., Brooklyn—$4,000,000 will be expended by city on sewer and road work this year. Repaving contracts let during

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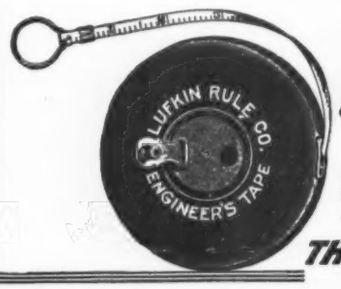

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first half of year amount to $741,507; contracts ready to advertise amount to about $690,600 (repaving); contracts also ready to advertise for street impvts. aggregating $180,600. Matters still pending, either in local board or before Bd. Est. and Apportionment, for which President Riegelmann expects authorization within few months, which will amt. to $500,000.

O., Cincinnati—City considering widening rdwy. of McMillan St.—Peeb corner to Almas Place—by 4 ft.; also repaving same. Abt. $50,000. F. Krug, city engr.

Ohio, Cincinnati—Ord. passed to proceed with impvt. of Gilbert Ave.—Van Zandt Rd. to Beising Ave.—by macadamizing rdwy. and laying necessary drain pipe; also DeArmond Ave.—Hamilton to Simpson Aves., and Knollman Ave.—South Corp. line to Van Zandt road.

O., Cleveland—Ordinance No. 49,805, introduced to issue bonds in the sum of $400,000 for the purpose of paving streets, C. J. Benkoski, clerk.

O., Cleveland—City contemplates widening Superior Ave., NE—E. 12th St. to E. 54th St. Plans provide a maximum width of 76 ft.; also Chester Ave., NE—E. 17th street to E. 21st street. This last will require abt. $300,000. Bonds expected to be issued soon. Steps soon to be taken to extend extension of Carnegie Ave., NE. to E. 107th St.

O., Elyria—Plans and specfs. for completion of conc. hwy. O Lorain to Oak Point—will be submitted to State Hwy. Commr. With approval of State Bd. county will be asked to issue road bonds in sufficient amt. above the $50,000 to be given by the state for this purpose. Connecting link will cost over $150,000.

O., Niles—Ord. adopted to improve entire length of Mahoning St.—Robbins Ave. to Fenton Street—by grading, draining, curbing and paving. S. A. Cartwright, Pres. of Council; Homer Thomas, Clk.

O., Oxford—The village council contemplates street paving work to cost about $29,000.

Okla., Edmond—Chamber of Commerce considering many improvements in town, chief among which is the paving of streets in section along Broadway, dist. of 4 blks. so. of Main and 4 blks. no; thence west to the Santa Fe right-of-way and east to Normal street.

Okla., Okmulgee—City Engineer ordered to prepare plans and estimate of cost of repaving and resurfacing all of Dist. No. 1 of Okmulgee.

Ore., Bend—Property owners on two of the chief residence streets have started petitions for conc. or bithu. pavements, with conc. curbs and walks. Little difficulty will be experienced in obtaining required number of signatures.

Oregon—State considering construction of 2.4 miles Grants Pass-Crescent City Rd. Est. cost $52,500; 10.4 mi. Ochoco Canyon Rd., $188,000; 22.2 mi. Medford-Klamath Falls Sect. of Crater Lake Rd., $246,000; 53.8 mi. McKenzie Pass Hwy., $356,000; Fed. Govt. will share part of expense. H. Nunn, Salem, State Hwy. Engr.

Pa., Philadelphia—Hwys. in Abington Twps. will be reconstructed as result of issuance of $40,000 bonds.

S. D., Sioux Falls—Paving of N. Iowa Pike from So. Dakota state line just east of Canton in Lincoln Co., thru counties of Sioux, O'Brien, Clay, Palo Alto, Kossuth, Hancock, Cerro Gordo, Floy, Fayette and Clayton to N. McGregor on Miss. River, is now assured. Bonds for the work carried by large majorities in the several counties.

Austin, Tex.—Atty. General has approved and Comptroller registered bond issues for City aggregating $1,890,000.

Tex., Corpus Christi—Nueces County votes two million dollars in bonds for constr. of a modern highway system.

Tex., Dalhart—Engineers have completed survey of principal streets preparatory to starting paving of several miles of city streets.

Tex., Eastland—The City will spend $200,000 for street paving. Work on more than 15 miles of brick and bitulithic paving will be started soon. Plans are already now.

Tex., Port Arthur—City contemplates improving with shell 40 miles of streets in the business section. $270,000. L. A. Witter, Clk.

Tex., Rockwell—Rockwell County Commrs. considering constr. of 13½ mi. highway and bridge over Trinity River; $45,-340,000. Julian Montgomery, Co. Engr.

Tex., Sisco—The City will soon award a contr. for 40,000 sq. yds. of street paving mostly in the business district.

Tenn., Dyersburg—City considering paving 30 blocks with asphalt.

Tenn., South Pittsburg—This city has decided to begin extensive street and sewer improvements. Cedar Ave. will be paved its entire wide of 50 ft. with concrete from first to 5th sts. A semi-circular sewer of 8 ft. diameter and 2,000 ft. long wtih lateral connections will also be constructed. Werter Hackworth of Jasper, Tenn. is the engineerr in charge. Estimated cost $75,000.

Va., Bristol—The City has issued $100,000 in paving bonds.

Va., Richmond—The State of Virginia is considering a plan to spend on road construction in the next 10 years $62,000,000.

Wn., Bremerton—Council has ordered improvement work amounting to $100,000. Work consists of two paving projects.

Wash., Kent—Resolution passed by Council to improve 10 additional blks. in residence sect. Work will consist of grading and graveling.

Wash., Leavenworth — At meeting of County Good Rds. Comm., it was decided to adopt a road bldg. program as follows: Concrete road betw. Wenatchee and Leavenworth, abt. 20 miles, at est. cost $597,000, of which $300,000 will be paid out of the bond issue, to which must be added $70,000 for the Cashmere bridge and $10,000 for the Peshantin brdg., making approx. cost of conc. road betw. Leavenworth and Wenatchee, $880,000. It has been recommended that elec. be called, bonds issued and sold at earliest possible moment.

Wash., Seattle—Council has passed Ord. providing for improvement of Wilson Ave. Et. cost $368,000. Impvt. will include paving thru large section of Rainier Valley adjacent to Lake Washington.

W. Va., Wheeling—Bids will be soon advertised for paving of S. Eoff St.—33rd to 39th; 39th St.—Eoff to Jacob and Jacob St. —39th to Wheeling-Benwood corp. line at 48th street. Specfs. for the streets in this section provide for 4-in. vitr. paving blk. upon a 6-in. conc. base and 2-in. cement and sand cushion.

Wis., Marshfield—A system of concrete roads for Wood county to cost $1,500,000 is under discussion.

Wis., Racine—County has voted to issue bonds in the sum of $2,350,000 for the purpose of constructing 125 miles of good roads in Racine Co.

Wis., Sheboygan—City considering plans to grade and pave 2:1 miles Michigan Ave., 17th St. to city limits, 18 ft. wide, involving 15,000 sq. yds. 2-course conc. and conc. curbs and gutters. Abt. $25,000. C. Boley, City Engr.

Wis., Superior—City having plans prepared for widening 16th St. and extending Lamborn Ave., or bldg. alley betw. 16th St. and Grand Ave. Abt. $15,211. M. G. Beckley, Clk.

SEWERAGE AND SEWAGE TREATMENT.

Ala., Samson—Ord. passed by Town Council to install modern sewerage system.

Cal., Glendale—Olmsted & Gillelen, Hollingsworth Bldg., Los Angeles have been retained by the City Trustees to prepare comprehensive report and plans for sewer system and disp. works. Will probably cost abt. $400,000.

Cal., Los Angeles—Resolution adopted by Council to construct clay pipe sewer in Sunset Blvd. betw. St. Andrews Place and Van Ness Ave.

Cal., Willows—$40,000 bonds voted for purpose of bldg. sanitary sewerage system.

Conn., New Haven—City will repair sewer system. Est. cost $55,000.

Conn., Portland — Town contemplates sewer construciton. Est. cost $50,000.

Fla., Fort Myers—Ordinance introduced ordering construction of sewers of 8, 12, 15 and 24 inch pipe in various streets. J. W. Owens, City Clerk.

Ill., Cairo—City is considering sewer construction to cost about $46,000.

Ill., Carlinville—Town considering extension of sewer system to north part of city. $42,124.

Ill., Galesburg—City Council has passed ordinance for sewers, paving and decorative lighting.

Ill., Hillsboro—Residents have requested City Commrs. to install sewer system in town; also extend water mains.

Ill., Wyoming—Bd. of Local Impvts. of Wyoming has received estimate of $22,000 on proposed addition of several blocks to sewer system of city. Immediately upon return of Mayor Walker, it is expected the estimate will be accepted.

Ia., Dexter—City considering constr. of sewer system and sewage disp. plant. Preliminary est.—20,000 ft. 8-in. pipe, 4,250 ft. 10-in. pipe, 5,500-ft. 12-in. pipe, 450 ft. manholes, 62 cu. yds. conc., 1,030 cu. yds. filtre sand, 82 cu. yds. filtre gravel. When this job is brought to letting, town will at same time ask bids for water distribution system consisting of one 40,000-gal. stand pipe, one 15 h p oil engine or motor,, and 200 gal. per min. pump, one 12x16 ft. brk. pump house, 22,000 ft. 4-in. cast iron pipe, 7,000 ft. 6-in. c. i. pipe and 26 hydrants. Theo. S. DeLau, Civ. Engr. Creston.

Ia., Inwood—Plans completeed for constr. of sewerage system to be installed some time this summer or fall.

Ia., Keokuk—City has authorized constr. of sewers in Blocks 72, 71 and 75. O. W. Sandberg, City Clk.

Ia., Keokuk—Council has ordered constructed the sewer from Rock Hall to an intersect. with another sewer at Fourth St.

Ia., Wapello—Resolution providing for constr. of sewer line on State St.—corner of Davidson residence to city limits—passed by Council. Project covers approx. 3½ blks.

Ind., Kendallville—City Clk. instructed to ask for bids for constr. of big storm water sewer, to provide adequate surf. draing. for entire so. eastern sect. of city. Specfs. call for two contracts—total $30,000.

Ind., Lafayette—City council plans to build a trunk line sewer in the seventh ward, continuing the present sewer on

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Greenbush St. from 15th St. to the Wabash railroad tracks.

Ind., Plymouth—New sewer will be constructed in Bollmans second addn. It will be laid in alley parallel with Jefferson and Rex streets and reach West to Roy street and so. to Gibson and no. to Jefferson Street.

Ind., Wakarusa—Town Board has ordered sewer constructed for purpose of improving draing. of Elkhart St.

Kans., Abilene—City Commrs. have decided to construct sewers on 11th Street.

Kans., Hutchinson—Resolution adopted by City Comn., for constr. of sanitary sewer betw. 7th and 8th streets, extending from Severance to Baker. Ord. providing for several new sanitary sewers in northwest portion of city passed at meeting.

Kans., Parsons—Plans and specfs. for new storm sewer system for the Third Ward adopted by City Comn. City Engr. W. H. Kutz estimates cost of main 4-ft. sewer to be from $45,000 to $50,000; and cost of extending draing. system, as ultimately planned, about $100,000.

Mich., Detroit—Sewer will be built in Conners Creek. Resolution will be introduced immediately with plans for Conners Crk sewage treatment plant and for sewer in Conners Rd.—Seven Mile rd. to Kercheval Ave.; from Kercheval avenue to the river the sewer will run in the bed of the creek. Sewer will drain 35 square miles of city. The complete project will cost, including the disposal plant, $14,000,000. $7,000,000 worth of contracts have been let.

Mich., Detroit—Geo. Engel, Commr. of Public Works, will request Council for $1,377,000 for immediate sewer constr. to relieve congestion on the Woodward Avenue sewer, appropriation to be made against next year's budget.

Mich., Detroit—City Council has passed an ordinance providing for a $3,100,000 bond issue for the construction of a sewer under Connor's Road. The sewer will be of two-barrel construction, 20x33 ft. 8,010 ft. long, running from Connor's creek treatment to the river.

Mich., Hubbell—Village Engineer is rushing plans for installation of sewer system and will soon call for bids.

Mich., Hudson—Tax payers have petitioned the city council to put in a sewer system from the top of the hill from Oak St. south to Division St. and down Division St. to the river.

Mich., Mt. Pleasant,—Had a special election. Mt. Pleasant voted in favor of bonds for constructing sewers on the east and west sides of the Chippewa River at $104,-000.

Miss., Brookhaven—Ord. passed by Council directing City Atty. to take steps towards issuance of city bonds not to exceed $100,000 for installation of model and complete system of sewerage for Brookhaven.

N. M., Santa Fe—City considering laying 13,800 ft. 6 and 8 in. vitr. sanitary and storm sewers in Palace, Grant and Lincoln Aves. and Johnson and Don Gasper Sts., involving 5,800 cu. yds. excav. W. G. Turnley, City Engr. About $13,000.

N. Y., Binghamton—Ordinance introduced in city council to construct storm water and sanitary sewer along Trout Brook from Glenwood Avenue to Shenango River, at est. cost of about $175,000.

N. Y., Brooklyn—Bd. of Est. will soon pass upon plans for Woodside trunk sewer. This sewer will be largest built in Queens up to present time. Approx. cost $4,000,000.

N. Y., Brooklyn—Finance Comm. Bd. of Estimate has reported favorably on request of Boro. Pres. Riegelmann for application of $300,000 to repair Greene Ave. storm sewer betw. Lewis and Marcy avenues.

N. Y., Syracuse—City contemplates bldg. storm and sanitary sewers in 3 sections of Glenwood Ave., 1,400 ft. long. About $10,-000. H. C. Allen, City Engr.

N. C., Burlington—City will construct 5 miles of sewer; together with disposal plant; also double present water supply by bldg. dam across Stone Creek and piping 7 miles to city. E. B. Horner, Mayor. Engineer not selected.

O., Chillicothe—Ordinance No. 603 passed to proceed with construction of sanitary sewer in Watt street, etc. R. T. Weaver. City Clerk.

O., Troy—Council has decided to construct two sanitary sewers; one Penn. Ave., May to Wheeler streets and one on Wheeler St.—Baltimore and Ohio Railroad.

Vermillion, O.—Resolution adopted to construct sewers, house connections and sewage plant in and for village. W. H. Mitchell, Mayor. Lewis Blatner, Clerk.

O., Youngstown—Resolution number 22,-763 introduced decvlaring intention to construct sewer in Springdale Avenue, etc. J. N. Higley, President of Council. M. F. Hyland, Clerk. A. W. Craver, Mayor.

Okla., Broken Bow—$30,000 bonds voted for constr. of sewer system.

Okla., Enid—$185,000 voted for sewage disposal plant.

Okla., Guthrie—$70,000 for constr. of sewer system and $80,000 bonds for water works system in town of Cardin, Ottawa County, approved by Attorney General's Dept.

Okla., Pawhuska—Ord. passed providing for issuance of sewer extension and impvt. bonds in sum of $79,380, authorized at election.

Okla., Verden—City contemplates constr. sanitary sewer system. H. A. Cranwell, City Engr. Chickasha, retained to make survey and draft and est. of improvement.

Ore., Portland—City Council considering bldg. trunk sewerage system in E. 57th St. Klickitat to E. 60th St., so. to center Hancock St., Hancock St. to E. 62nd St., to center of Hlsey St., east to E. 63rd to connect with sewer in E. 63rd and Willow Sts. Abt. $180,780. O. Laurgaard, City Eng.

Pa., Ferndale—Owen & Plummer, have completed plans for proposed sanitary sewer for Borough. Plans and specfs. also completed for big paving program. Work will amount to $50,000 to $100,000.

Pa., New Philadelphia — Engineer instructed to prepare specifications for sanitary sewer on Wabash avenue—Prospect street to Union avenue; also for sanitary sewer requested by property owners at Cross and Sherman streets.

R. I., Cumberland (Manville, P. O.)—City plans to build new sewerage system. About $150,000. O. P. Searle, 146 Westmnister St., Providence, Engr.

S. D., Iroquois—At special election voters authorized and carried $35,000 bonds for sewerage system and $20,000 for extension and impvt. of municipal water works system.

S. D., Menno—By vote of 7 to 1 the issuance of $35,000 in bonds for installing a new sewer system has been authorized.

Tenn., Knoxville—City Comn. have authorized $100,000 bonds for sewer extension and bridge construction.

Tex., Bryan—City Comn. having survey made of city with view to extending pres-

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ent sewer system to include sects. of city now out of the sewer limits. Prof. J. C. Nagle, appointed Consult. Engr. and work is being done under his direction.

Wis., Eau Claire—City is planning to raise $75,000 for sewer extensions and construction of trunk sewers.

Wis., Marion—A movement has been started here for a sewer system.

Wis., Sturgeon Bay—Council has passed resolution for sewers and water mains on Sherman street. J. C. Langemack, City Clerk.

Wis., Waukesha—City will construct sewers on White Rock Avenue; 378 lin. ft. T. C. Martin, City Clk.

WATER SUPPLY AND PURIFICATION

Ark., Conway—City may improve water works system. Work will include following: large settling basin, completion of emergency steam power pumping station;; replacing with wooden mains the defective portions of present wooden mains. L. V. Leveret, Supt. of Bd. of Commrs.

Ark., Springdale — City will construct $150,000 water system and $200,000 sewer system. J. S. Ewalt is Mayor and Frank L. Wilcox, St. Louis, Mo., is the consulting Engineer.

Cal., Arcadia—$150,000 bonds voted to increase and extend city water supply. Additional wells will be drilled and another reservoir of one million gals. capy. will be constructed. Water will be pumped from existing reservoir into new one. H. S. Gierlich, City Engr. Willis S. Jones Claremont, Consultg. Engr.

Cal., Oildale—$40,000 bonds voted by Water Dist. No. 1 for water system. Water will be secured from wells driven 3 mi. no. of Bakersfield. System will be constructed under supervision of Co. Surv. A. E. Stegeman.

Cal., Pasadena—S. B. Morris, Chf. Engr. Water Dept. recommends that money be set aside from general fund to constr. proposed distributing sys. for San Rafael Heights district. Est. cost $100,000. Provision must also be made for booster pump & reservoir to cost $16,000 to $18,000. $15,000 available for constr. wk. in tunnels & $25,000 for deepening and equipping Woodbury and Franklin wells.

Cal., Riverside—Bd. Pub. Utilities has requested City Eng. Braunschweiger to prepare estimates of cost of proposed extensions to municipal water system to serve Magnolia Ave. N., Monroe street and other districts. Bond issue will be necessary.

Cal., San Francisco—Bd. Public Wks. authorized to purchase 350 meters for municipal water system.

Fla., Belleview—Belleview Utilities Co. organized. Edw. S. French, Secy. Considering water works extension; galvanized iron pipes; wood frames; $2,500; supply 25 families; electric double-acting pump; contemplate 5,000-gal. pressure system. Jas. Conway, Engr., Harvard, Ill.

Ga., Columbus—City—Chas. F. Jordan, Supt.—will make following water works impvts.: $15,000, filter, increase daily capy. 1,000,000 gals.; 6,000,000 gals. capy. pump; several hundred meters.

Ill., E. Moline—Council has submitted Ord. for water main extension to involve expendt. of $41,000.

Ill., Virden—Water Wks. Comm. of City contemplate constructing several relay dams on Sugar Creek; a high reservoir to be made by W. A. Fuller of Fuller-Beard Engrg. Co., St. Louis.

Ind., Evansville—Water Works Department will encourage installation of water meters.

Ind., Mishawaka—A one million gallon reservoir, tank and stand to cost $50,000 may be installed in Mishawaka in connection with the equipt., for public water supply.

Ind., Warsaw—Water works improvements will be made in Warsaw under the formal order of the Indiana public service commission. J. A. Craven, Merchants Bk. Bldg., Indianapolis, Ind. is consulting engineer.

Kans., Dodge City—Utility Comm. has allowed $37,000 to improve water works.

Kans., Elkhart—$60,000 additional bonds voted for extension of city water and electric light plant.

Kans., Harper—City having plans prepared by W. B. Rollins & Co. Engrs. 209 Ry. Exch., Kansas City, Mo., for improving water works system, including installation of pumping equipt., engine, generator and pipe lines. About $35,000.

Kans., Pretty Prairie—Petitions are out for a bond election for a water system for this town to cost about $32,000.

Ky., Maysville—City considering construction of water works impvts. W. L. Glazier, Surv. Newport, Ky.

Minn., Buffalo—The City is planning to spend about $25,000 on water main extension work. B. A. Bonstrum is City Clerk.

Minn., Hibbing—Plans drawn for extension of water works system to Kitzville. Chas. Foster, Supt. of Water & Light Plant drew the plans.

Mich., St. Clair Beach (P. O. St. Clair)—Plans being prep. by R. A. Murdock, Engr., 706 Free Press Bldg., Detroit, for bldg. system of water mains, involving 7,000 ft. 4-6 in. water pipe, 12 hydrants, valves, etc. Abt. $10,000.

Mo., Boonville—Chas. voted $45,000 bonds for impvt. of water works. Chas. W. Journey, Mayor.

Mo., Weston—City contemplates constr. of water works impvts.: deep well and rein. conc. reservoir. $20,000. W. B. Rollins & Co. Engrs., 209 Railway Exchange Bldg., Kans. City.

Neb., Howard—City Council contemplates extension of water mains south of town.

N. J., Pittman—Plans being prepared by Remington & Vosbury, Engrs., 601 Market St., Camden, for bldg. stand pipes, drumming stations and mains for distribution.

N. Y., Buffalo—City considering installation of filtration plant in public swimming pool. Est. cost $36,000.

N. Y., Herkimer—$750,000 bonds voted to build rein. conc. storage reservoir and dam, and install complete gravity system near Gravesville. Russia Twp. C. L. Wood, City Engr.

N. C., Wendell—City has voted $88,000 in bonds to construct water and sewer systems.

O., Cleveland—Ordinance No. 49,742 introduced in city council to issue bonds in the sum of $80,000 for the purpose of constructing water mains.

O., Fremont—City Council plans to extend water main from Memorial Hospital across McKinley St. to the dead end of the water main on Hayes Ave. The money for this work is available.

O., Hamilton—City Council contemplates extending water service to all the new subdivisions at cost of about $148,000 and calling for over 29,000 ft. of pipe of various sizes. The price given is exclusive of the cost of labor for installation.

O., Toledo—Plans being prepared for bldg. 22 filters, 1,000,000-gal. capy. daily, 20x50x500 ft. setlling basin, 11,250,000-gal. capy. and several miles 30, 32 and 40 in. c. i. mains. Bonds for $850,000 voted for project. H. C. McClure, City Engr.

O., Toledo—Commrs. Lucas Co. passed resolutions to construct Water Line No. 12, involving 5,680 ft. 6-in. and 1,510 ft. 8-in. c. i. pipe. About $14,500. L. A. Boulay, Courthouse, Engr.

Okla., Broken Bow—$100,000 bonds voted for water works system.

Okla., Comanche—A. L. White, Clk. & Supt. of Town. Water works constr. $25,000; 200,000-250,000 gals. daily; intern. combustion gas engines.

Okla., Enid—$320,000 bonds voted for water works impvts.

Okla., Perry—$260,000 bonds voted for bldg. water, light and park systems.

Okla., Ponca City—$150,000 bond issue to be voted on for constr. of water works system.

Okla., Shawnee—$220,000 water works plant to be erected here, in addition to plant already in existence. Bonds voted.

O., Sydney—W. J. Sherman Co. Engrs. Toledo, retained by City to investigate and report, with recommendations, on improved water supply.

Pa., Pittsburgh—$1,401,000 bonds voted to improve and extend water supply system. N. S. Sprague, Chf. Engr. Dept. Pub. Wks.

S. D., Iroquois—$35,000 sewerage bonds voted at special election.

S. D., Sioux Falls—Resolution will be presented to City Commrs. for calling special elec. to vote on bond issue of $300,000 for purpose of bldg. iron removal plant and making extensive impvts. to water works system. Consult. Engr. Dabney H Maury.

Tex., Palestine—$250,000 bonds voted for water works.

Tex., San Angelo—San Angelo has decided to construct water, light and power plant. $500,000 bonds voted in March.

BRIDGES AND BUILDINGS.

Ala., Mobile—Resolutions asking immediate passage by Ala. legislature of bill to appropriate money for constr. of brdg.—Mobile to Baldwin—endorsed by Mobile-Baldwin Hwy. Assn.

Cal., Hanford—Co. Surv. Roy May instructed by Bd. of Supvrs. to prepare plans for rein. conc. bridge over Kings River so. of Kingsburg. Brdg. will be abt. 500 ft. long.

Cal., Pasadena—Plans prepared by Asst. City Engr. E. P. Dewey for rein. conc. brdg. 355 ft. long with 154-ft. cantilever span & Carrying 20-ft. rdway, walks on each side and ornamental lights, over Arroyo Seco several blks so. of Calif. street bridge. Est. cost $60,000.

Cal., San Bernardino—Election will be held to vote on issuance of bonds for two new bridges; one over Lytle creek to cost abt. $50,000 & one over Warm creek to cost about $10,000. W. L. Brown, City Engr.

Cal., Santa Paula—Nearly $50,000 raised by subscription among business men of Santa Paula for constructing brdg. 900 ft. long over Santa Clara river. Est. cost $50,000.

Del., Wilmington—Levy Court, Newcastle Co., authorized to borrow $550,000 for constr. of new bridg. across the Brandywine river at Washington street.

Ind., Indianapolis—Council will consider appropriations of $225,000 to build brdg. over Northwestern Ave. & Michigan Rd., and $75,000 to replace Dawson brdg. over White River on Nora and Allisonville pike.

Kans., Republic—Bd. County Commrs. have promised to construct new brdg. across Republican River, 2 mi. so. of town, to replace old Pawnee brdg.

Md., Pocomoke City—State Rds. Comn., 601 Garrett Bldg., Baltimore, submitted plans to U. S. Engr's Office, for 270 ft. rein. conc. bridg. over Pocomoke River. Abt. $150,000. J. N. Mackall, State Hwy. Engr.

Mich., Detroit—City expects to begin work about October 1st on Belle Isle bridge. Surveys covering location of sewers, water mains and elec. conduits at intersect. made.

Minn., Fergus Falls—Plans completed for 2 conc. bridgs. H. J. Collins, City Clk. A. C. Eschweiler, 720 Goldsmith Bldg. Milwaukee; 90-ft. span, 52 ft. wide.

Minn., Hibbing—Contracts soon to be let by County Commrs. for constr. of 8 concrete bridges to replace wooden structures. Plans now on file office of County Engr., Geo. Lehman in county court bldg. at Hibbings.

Minn., Hibbing—St. Louis County will soon ask bids for constr. of 15 brdgs. One of the largest, 70-ft. brdg. on Meadowlands trunk rd. Geo. Legman, now working on this road. W. H. Borgen, Co. Aud.

Minn., Springfield—Brown Co. contemplates new brdg. to replace Burns brdg. State Hwy. Commr. expected to prep. plans soon. Louis Vogel, Aud.

Mont., Butte — Beaverhead and Silver Bow Counties have decided to jointly construct bridge across Big Hole at Melrose. Bids will be asked in the near future. No bid over $19,999 can legally be considered as Commrs. of each county cannot expend more than $10,000 each for each county.

N. H., Manchester—Amoskeag br dge has has been condemned and will be replaced by new struct. if plans of finance comm. and approval of mayor are carried thru.

O., Cleveland—Asst. County Prosecutor Baskin will decide whether legal obstacles would prevent constr. of brdg. over Big Creek, W. 73rd St., without putting matter to a vote. Co. Commrs. have approved erection of the bridge which will cost $100,000.

O., Lima—Ord passed by Council to issue bonds in sum of $113,000 for purpose of paying cost and expense of constructing brdg. on Elm street over the Ottawa river; also brdg. on North street over Ottawa river; together with necessary abutms. and approaches.

O., Lima—County Commrs. have agreed to permit city to construct Metcalf street brdg., county paying $19,000 of cost. $28,000 bonds sold. City Engr. Miller instructed to prep. plans.

R. I., Pawtucket—State Bd. Pub. Rds. has filed new plans and specfs. for constr. of new brdg. at Coventry Centre, with Town Clk. Geo. B. Parker.

S. D., Big Stone City—Grant and Coddington County. Bd. making arrangements to constr. bridge betw. Sect. 4-199-51, Coddington Co. and Sect. 33-120-51, Grant Co., 30-ft. span. 20-ft. rdway brdg J. C. Cahill, Co. Aud. Grant Co. Milbank, S. D.

Tex., Austin—Plans submitted to G. G. Wicklins, brdg. engr. of state hwy. dept. for constr. of brg. across Sabine River at Orange. C. C. Belcher, Del Rio, has proposed a stone brdg. across Pecos River. Hwy. Dept. also considering plans for viaduct brdg. steel or conc. over Sulphur River.

Wis., Sturgeon Bay—City Utility Comn. will rebld. toll brdg. this winter. Probably edge plank; tarvia surf. comb. timbers, some piling, creo blks. being considered. Supt. J. E. Johnson.

Wis., Superior—36 bridges will be built by St. Louis Co. from recent bond issue of $1,350,000. 12 will be built with struct. steel with concrete reinforcement. Brookston brdg., is largest in first allotment. Est. quantity of 236,000 lbs. struct. steel will be required for this job. Another large brdg. will be constructed at Biwabik, requiring 78,834 lbs. of steel.

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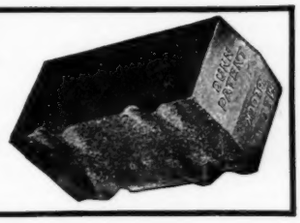

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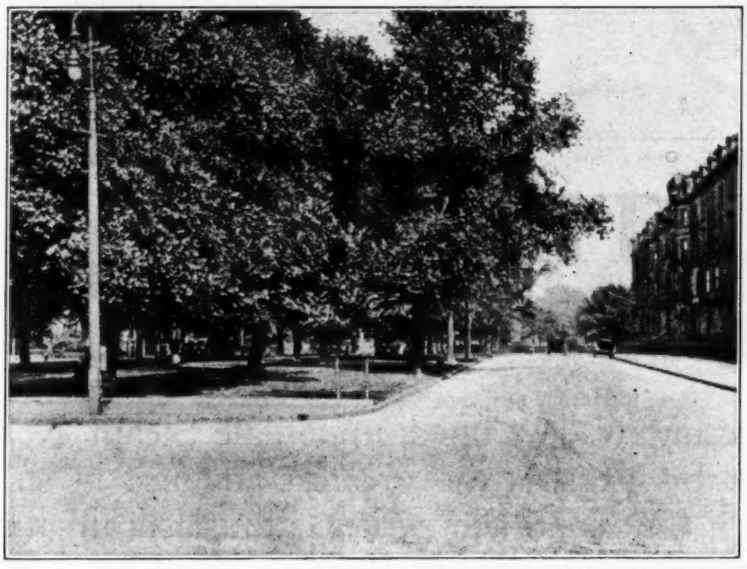

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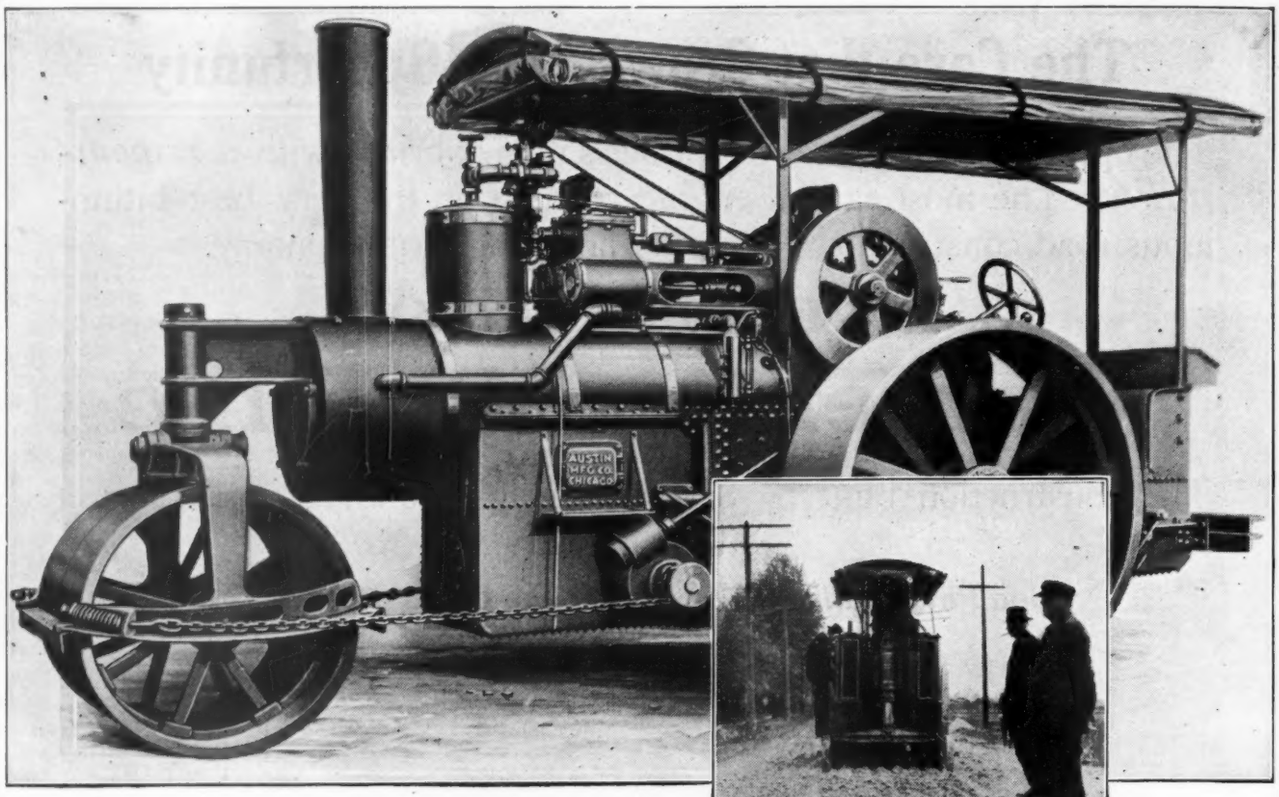

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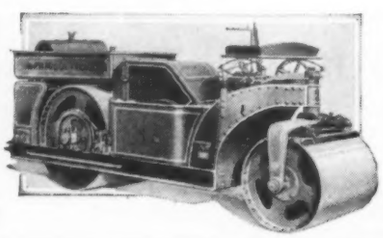

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